RIVERFRONT PARK BRIDGES

INSPECTION AND ANALYSIS

NORTH SUSPENSION BRIDGE

NOVEMBER 14, 2014 | Final Report

kpff Consulting Engineers

NORTH SUSPENSION BRIDGE

November 14, 2014

Prepared for

City of Spokane

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1. BRIDGE DESCRIPTION

The north suspension pedestrian bridge was built for the 1974 Expo to carry pedestrians and bikes across the north channel of the Spokane River in Riverfront Park. The single-span North Suspension Bridge is 295 feet in length from tower to tower. The bridge superstructure is supported by hanger cables vertically connected to the main cables which are suspended from the towers. The floor system consists of weathering-steel edge girders, a concrete deck, horizontal bracing and a floor-beam that supports 15 electrical conduits running below the deck between vaults. The deck consists of reinforced concrete with stay-in-place (SIP) steel forms. Large hollow vaults that encompass the lower portion of each tower below the deck level have a ceiling/ cover that serve as an approach span. This span is constructed from concrete filled stay-in-place deck.

Figure 1: Aerial view of the Suspension Bridges (© 2012 Google Inc.)

2. DOCUMENT REVIEW

In preparation for this evaluation, Kpff reviewed the following documents related to the North Suspension Bridge:

- Structural design drawings (Plan no. G9-G15)
- Previous routine inspection reports
- Ultrasonic testing report (2009)
- Vault inspection report (2011)

3. EVALUATION PROCEDURES

ROUTINE BRIDGE INSPECTION

The bridge was closed to pedestrian traffic for the duration of the bridge inspection. The maintenance department at Riverfront Park provided closure signs.

A visual inspection of the top of the deck, railings, and cable anchorages was performed. These components were accessed by foot. The curb and deck were sounded with a rock hammer to identify areas of delaminations. A visual inspection of the steel framing system, hanger cable bolt connections, and the bottom of the deck (SIP forms) was performed. These components were accessed by a climbing system anchored to the hanger cable connection above the curb and a back-up safety line anchored to the metal railing. The girder flanges and webs were measured with a D-meter and/or calipers at locations which showed evidence of section loss. A hands-on visual inspection of the main suspension cable connections at the towers, spreader bars and adjacent suspender cables was performed. These components were accessed by ascending a rope anchored to the spreader bars. The remainder of the hanger cables and the main suspension cables were also inspected. These cables were accessed with a 32-foot extension ladder (provided by the Riverfront Park maintenance department). A visual inspection of the vaults at the concrete towers was accessed by an extension ladder (provided by Avista). The vaults are considered a confined space; air monitoring equipment was provided by Avista.

STRUCTURAL ANALYSIS

The main suspension cables, hanger cables, and steel girders were load rated using the LRFR method. The analysis was performed using CSiBridge. A uniform pedestrian live load of 90 psf and two vehicle live loads (6-foot-7-inch wheelbase/16,200 pounds and 8-foot-3-inch wheelbase/21,190 pounds) were used in the analysis. The vehicle weight distribution was assumed to be 75 percent of the total weight at the front axle and 25 percent of the total weight at the rear axle. The analysis assumed that there was only one vehicle on the bridge at a time and the vehicle load did not act concurrently with the uniform pedestrian live load. No impact was included for the live loads.

4. EVALUATION FINDINGS

BRIDGE INSPECTION

The elements with the heaviest corrosion and overall deterioration are the deck, floor-beams, hanger cable bolts, and conduit roller supports. The construction joints in the deck allow water to penetrate through the top. The water is trapped in the SIP forms until it eventually rusts through. The water leaking through the deck and corroded SIP form eventually causes corrosion of the floorbeams and the conduit supports. Many of the horizontal plates connecting the lateral bracing to the girders are filled with debris, which traps moisture and causes the connections to corrode.

The metal railing, main suspension cable, hanger cables, steel pins, concrete towers, and cable anchorages are all in good condition. The steel girders are, overall, in satisfactory condition, with the exception of a few isolated areas that have moderate corrosion.

The concrete anchor blocks at the northwest and southeast ends of the bridge are buried. There is soil around the northeast and southwest anchors. The lock nut at the southwest anchor is only 30 percent engaged.

The SIP forms and steel supports in the vaults are severely corroded. The heaviest corrosion occurs at the locations were water can penetrate from the top of the deck. This includes areas around the manhole, around the concrete tower, and at the expansion joint at the bridge abutments. A large section of the SIP formwork is no longer in place adjacent to both bridge abutments.

The bridge inspection report, element numbering system, and photographs are included in Appendix A.

STRUCTURAL ANALYSIS

The load rating analysis is reported as a Rating Factor (RF). The RF is the ratio of available capacity in each primary superstructure component over the specified live load combination under investigation Based on AASHTO specifications, a RF less than 1.0 is interpreted to mean that one or more of the superstructure components do not meet current minimal capacity code standards and consideration should be given to either strengthening the subject component(s), or posting a sign identifying a maximum allowable load for the structure linked to the actual RF of the structure. Rating factors greater than 1.0 are interpreted to mean that all of the superstructure components have sufficient capacity to safely support the load under investigation, per the AASHTO specifications.

The minimum rating factor under the pedestrian live load, excluding the deck, is 1.08. The associated controlling component is the axial strength of the backstay anchorage cable. The minimum rating factor under the inspection vehicle live load is 1.45. The associated controlling component is the girder in flexure.

An analysis of the deck based on its current existing condition was also performed. In the original design of the deck the SIP forms were designed as a permanent structural member. Since the SIP place forms are heavily corroded in many locations, they were ignored for determining the capacity of the deck. The deck was analyzed assuming the average moment demands between a fix-fix and pin-pin connection between the slab and girders. The capacity of the deck is based on the tensile strength of the concrete. This analysis resulted in a RF = 0.51 for the deck in flexure under pedestrian loads. A load rating for the deck under vehicle loads was not performed, since vehicles are not currently allowed on the bridge.

The load rating calculations are included in Appendix C.

5. CONCLUSIONS AND RECOMMENDATIONS

The North Suspension bridge structural condition, minus the deck, can be characterized as very good to fair - depending on which part of the bridge is being viewed. In General, the area above the deck including the tower is very good and the areas below the deck are satisfactory to fair. The steel area below the deck will be further investigated and upgraded as needed under our recommendations. Upon completion of this rehabilitation work the area both above and below the deck can be considered to be in good to very good condition. Some minor defects will remain but they will be immaterial to the inherent structural functioning capacity of the bridge as a whole.

In general, structural steel components that support bridges are conducive to corrosion from environmental conditions such as water, moisture, salts, air pollution, dirt and plants, bird droppings and bird nests. The more these items are kept a bay the longer the bridge will last. Maintenance is critical, especially in the form of cleaning and removing debris, bird nests and droppings from anyplace on the structure they can or do collect. The

Suspension bridges structural components while experiencing all degrees of corrosion (minor to severe) over the past 30 years has really overall performed fairly well.

Currently, there is no reason to suspect that this bridge will not be in service for at least another 50 years if repaired as recommended below, bi-annually inspected and maintained (cleaned) on an annual basis.

The steel used for this bridge is weathering steel. Its protective coat is a result of a thin film of rust. It is an excellent system for this environment. However, if over time this protection system appears to degrade, painting the bridge becomes an option which can easily buy another 20 to 30 years of service life for those components. Currently we are recommending painting for those areas already exposed to at least moderate levels of corrosions – generally around the panel point connections.

The deck is in poor to critical condition and must be replaced. A new, properly designed and constructed, deck should function well for another 30 to 50 years. It is recommended that salt not be applied ever to the new deck. It is far better to close the bridge if it seems the slippery to walk on with snow and ice. Salt leads to deterioration of concrete, the deck SIP forms, and any part of the steel components it touches.

Overall, the suspension bridges and vaults require a substantial amount of rehabilitation work to preserve their lifespan. The details of the bridge and vault improvement plans are included in Appendix B, along with a detailed cost estimate. The combined total cost for the recommended repairs for the North and South Suspension Bridges and Vaults is $2.8 million.

Our recommendations to improve the bridge are summarized below.

DECK

Due to the heavy corrosion of the SIP forms and the numerous areas of delaminations in the concrete, the deck and curb should be replaced. The new deck should have an improved drainage system to prevent future corrosion of the superstructure. A drainage channel could be added along the curb. The deck should receive a waterproofing sealant.

STEEL FRAMING SYSTEM

The steel framing should be cleaned of debris and flaking steel. After the deck is removed and the steel is cleaned, another inspection should be performed to determine if there are areas of section loss that need to be reinforced. Floorbeams that are moderately to heavily corroded should be replaced. Floorbeams with minor corrosion should be cleaned and painted.

METAL RAILING

The hand rail screws that have been stripped between hangers H1-H2 RT and H6-H7 RT should be replaced.

The clear opening between the railing posts does not meet current code. Consideration should be given to modifying the railing to meet code when the deck is replaced.

HANGER CABLE ANCHOR BOLTS

The load rating analysis determined that the original anchor bolts had much more capacity than required based on the design loads. Therefore, if the anchor bolts only have a small to moderate amount of corrosion (less than 25% section loss), they will still have well above sufficient capacity to support dead and live loads. These anchor bolts should be cleaned of all rust and painted. Anchor bolts with severe corrosion (more than 25% section loss) should be replaced.

ELECTRICAL CONDUITS

The conduit supports at the floorbeams are heavily corroded. The conduits are corroded in many locations. The conduits will need to be removed in order to clean and replace the floorbeams. The estimated cost and improvement details assume that all of the conduits and supports will be replaced.

CABLE ANCHORAGE

The tree branches at the northwest anchorage should be cut back away from the cable. Expose the concrete anchorage blocks and remove the soil around the threaded rods. The lock nut should be tack welded into position at the southwest anchorage.

VAULTS AT CONCRETE TOWERS

The deck and the steel framing in the vaults should be replaced and additional framing around the manhole opening should be provided. The conduits should be removed during construction, and the new deck should be constructed with removable formwork. The sidewalk around the vaults should also be replaced. A compression seal should be installed at the expansion joints to prevent the large intrusion of water at the joint.

FUTURE INSPECTIONS

A routine walk-through inspection should be performed every two years. Kpff has provided inspection forms, which if utilized on a continual basis will, over time, provide an invaluable record of the bridge condition, areas of continual problems, and help inform the best way to care for the bridge and preserve the City's investment in its infrastructure.

6. PERMITS AND CULTURAL RESOURCE REQUIREMENTS

PERMITS

An environmental permit matrix was prepared by SWCA Environmental Consultants for the Riverfront Park Bridges. The proposed bridge improvement work may require the following permits or approvals:

- Hydraulic Project Approval permit from the Washington Department of Fish and Wildlife
- Critical Areas Review from the City of Spokane
- Shoreline Substantial Development Permit from the City of Spokane

More information can be found in SWCA’s report.

APPENDIX A

LIST OF PHOTOGRAPHS

CITY OF SPOKANE

PEDESTRIAN BRIDGE INSPECTION FORM

				Bridge No.	870
Bridge Name	North Suspension Bridge over Spokane River		**Bridge Location**	North abutment near W Broadway Ave and N Post St	
Inspection Date	9/3/14-9/5/14	**Inspector(s)**	Frymoyer, Whiteman, Georgieff	**Agency**	KPFF
Access Method	Climbing equipment-below deck and upper cables, 32 ft ladder-vaults, hanger cables			**Weather**	sunny / warm

Load Rating Date	Nov. 2014		**Live Load**	**Pedestrian**: 90 psf	**Vehicle**: Inspection Trucks
Load Rating Factor(s)	**Ped.** 0.51	**Veh.** 1.45	**Controlling Component**	**Pedestrian**: Deck	**Vehicle**: Girders

Description of Bridge

Pedestrian suspension bridge built in 1974. Bridge is 295 ft (tower to tower) in length. The primary structural system is: tower, main cables, hanger cables, longitudinal girder and deck. All steel is weathering steel. The deck cannot be seen from below due to the S.I.P forms. The floorbeams do not support the deck - they support 15 conduits. There is a large enclosed, hollow vault at each concrete tower.

Summary of Condition and Critical Findings

The heaviest corrosion occurs at the floor beams, the hanger bolt connections, and the lateral bracing connections. The longitudinal girders have also experienced localized areas of heavy corrosion where they connect to the floorbeam and hanger cable. The SIP deck forms are heavily corroded in some locations to the extent they are gone for small sections of deck. The main suspension cables, hanger cables, pins, towers, and anchorages are all in good condition.

Summary of Recommendations

1) Deck, heavily corroded floorbeams and hanger cable bolts should be replaced. 2) After deck is removed, each long. girder should be re-inspected to determine if there are areas of significant section loss that need repair. 3) Remove debris from the connections. 4) Remove tree branches around cable at NW anchorage. 5) Expose concrete anchor blocks and remove soil around threaded rods at cable anchorages. 6) Tack weld lock nut at SW anchorage. 7) Replace vault deck and supports. 8) Repair handrail cover plate.

Summary of Bridge Condition

Bridge Component		No. of Compon.	% of **	Condition Rating*			Comments
				8 – 7 Good	6 – 5 Fair	4 – 3 Poor	
1	Concrete Deck	1	area	60%	20%	20%	Cracks, spalls, delaminations, and exposed rebar throughout.
2	Metal Railing	2	length	100%	0%	0%	See notes next page.
3	Steel Floorbeams	19	length	25%	50%	25%	Floor beam 1-13 has the most corrosion/flaking.
4	Steel Girders	2	length	85%	12%	3%	Girder near H5 LT has the most severe corrosion.
5	Suspension - Main Cable	2	length	100%	0%	0%	Minor loss of galvanizing.
6	Hanger Cables	34	length	85%	15%	0%	See notes next page.
7	Steel Pin	8	each	100%	0%	0%	
8	Concrete Tower	2	length	100%	0%	0%	
9	Cable Anchorage	4	each	90%	10%	0%	See notes next page.
10	Soffit (stay in place forms)	1	area	75%	0%	25%	See notes next page.
11	Vault	2	area	85%	0%	15%	See notes next page.
12							
13							

*See Page 2 for detailed descriptions **Condition rating percentages are based on the % of area, length, or each of the bridge components inspected.

GENERAL NOTES

Vault #3 at Pier 1; Vault #4 at Pier 2.

DESCRIPTION OF CONDITION OF BRIDGE COMPONENT		
Condition Value	**Material**	**Description**
8 – 7 Very good → Good 2 yr. insp. Cycle No repairs.	Steel	Like new, surface rust, minor pitting, no material loss. Connections are good. No damage.
	Concrete	No to minor/ insignificant defects includes: cracks, spalls, chips, consolidation, efflorescence.
	Timber	Beams: Minor splits, checks, or defects (one side), no decay or insects – sounds solid. Posts: Splits or cracks less than ⅜" (one side), no decay or insects – sounds solid.
	Paint	No defects, no sign of rust including no freckled rust, no peeling, no exposed steel.
	Scour / Erosion	None or minor.
6 – 5 Satisfactory → Fair 1 – 2 yr insp. cycle Monitor for repairs Paint: Max 10 year life estimate	Steel	Moderate corrosion, pitting, flaking, pack rust. Material loss is evident but barely measurable. Connections have up to moderate corrosion but remain fully functional. No cracks.
	Concrete	Some spalling but exposed rebar (if any) is insignificant or exhibits some surface rust; delamination is evident with or without evidence of rebar corrosion. Shear zone cracks are tight, barely measureable, and low density. Flexure zone cracks are measurable but less than .035 inch and low density. Concrete may exhibit: efflorescence (moderate to heavy), surface rust, heavy map cracking, very poor consolidation. Settlement cracks in foundations and wall are stable and less than ¼" wide.
	Timber	Beams: Less than ⅜" splits – two sides or greater than ⅜" on one side. Some decay (max 10% by volume), some softness but sounds solid – no insects. Posts: More than ½ "splits – two sides or greater than ¾" on one side. Decay is evident (greater than 20% by volume), timber may have extensive wetness and softness.
	Paint	Freckled rust, small areas of exposed steel, some peeling, oxidized.
	Scour / Erosion	Evidence of scour, exposed footing, no undermining. Banks are sloughing, protection, if any, needs repair.
4 – 3 Poor → Critical 3 mo – 1 yr. insp. cycle (as needed) Repairs needed. (ASAP or one year) Re - paint	Steel	Heavy to severe: corrosion, pitting, pack rust. Measurable material loss. Connections are heavily corroded, missing, and questionable functionality. Fatigue cracks.
	Concrete	Large spalls, deep w/ exposed and corroded rebar w/ material loss evident. Cracks are wider, closely spaced, clearly structural in nature both in shear and flexure zone. Concrete quality appears poor w/ heavy scaling, stagilites, efflorescence, map cracking, extensive surface rust and delamination, and very poor consolidation of concrete. Settlement cracks are significant.
	Timber	Beams: Greater than ⅜" on two sides. Moderate decay up to 20%, surface softness, do not sound solid – may have insects. Posts: Less than ½ "splits – two sides or greater than ½" on one side. Decay is evident (20%), wetness and soft.
	Paint	Extensive freckled rust, larger areas of exposed steel, heavily oxidized, extensive peeling.
	Scour / Erosion	Undermining or threatens undermining in a manner that could impact structure stability. Banks are heavily eroded, protection if any is non-functional.

Additional Comments by Component Number

Bridge Comp. No.	Comments
2	Right handrail cover plate screw is stripped between hangers H1-H2 RT and H6-H7 RT.
6	Anchor bolts connecting hanger cable to girders are corroded. Interior connections have more deterioration than outside connection.
9	Concrete blocks at NW and SE anchors are buried. Soil around NE and SW anchors. 1/4" of movement at NE and SW anchors. Lock nut at SW anchor is only 30% engaged.
10	Stay in place deck form is heavily corroded to such an extent that in many locations it is gone. The most extensive deterioration is near floorbeam 1-8.
11	Stay in place deck forms are heavily corroded around manhole, column, and near bridge abutments. Steel angle support around column and support beams and angles are heavily corroded.

Photo 1 –North Suspension Bridge Deck (Looking North)

Photo 2 – North Suspension Bridge Elevation (Looking West)

Photo 3 – Exposed Rebar in Deck

Photo 4 – Loose Cover Plate on Handrail


Photo 5 – Moderate Corrosion/Flaking of Floorbeam 1-13


Photo 6 –Moderate Corrosion Bottom Flange of Left Girder at H5

Photo 7 – Debris at Panel Point (Typical)

Photo 8 – Typical Suspender Cable Connection

Photo 9 – Hanger H10 LT, Broken Cotter Pin

Photo 10 – Moderate to Heavy Corrosion at Interior Suspender Cable Connection (H5 RT)

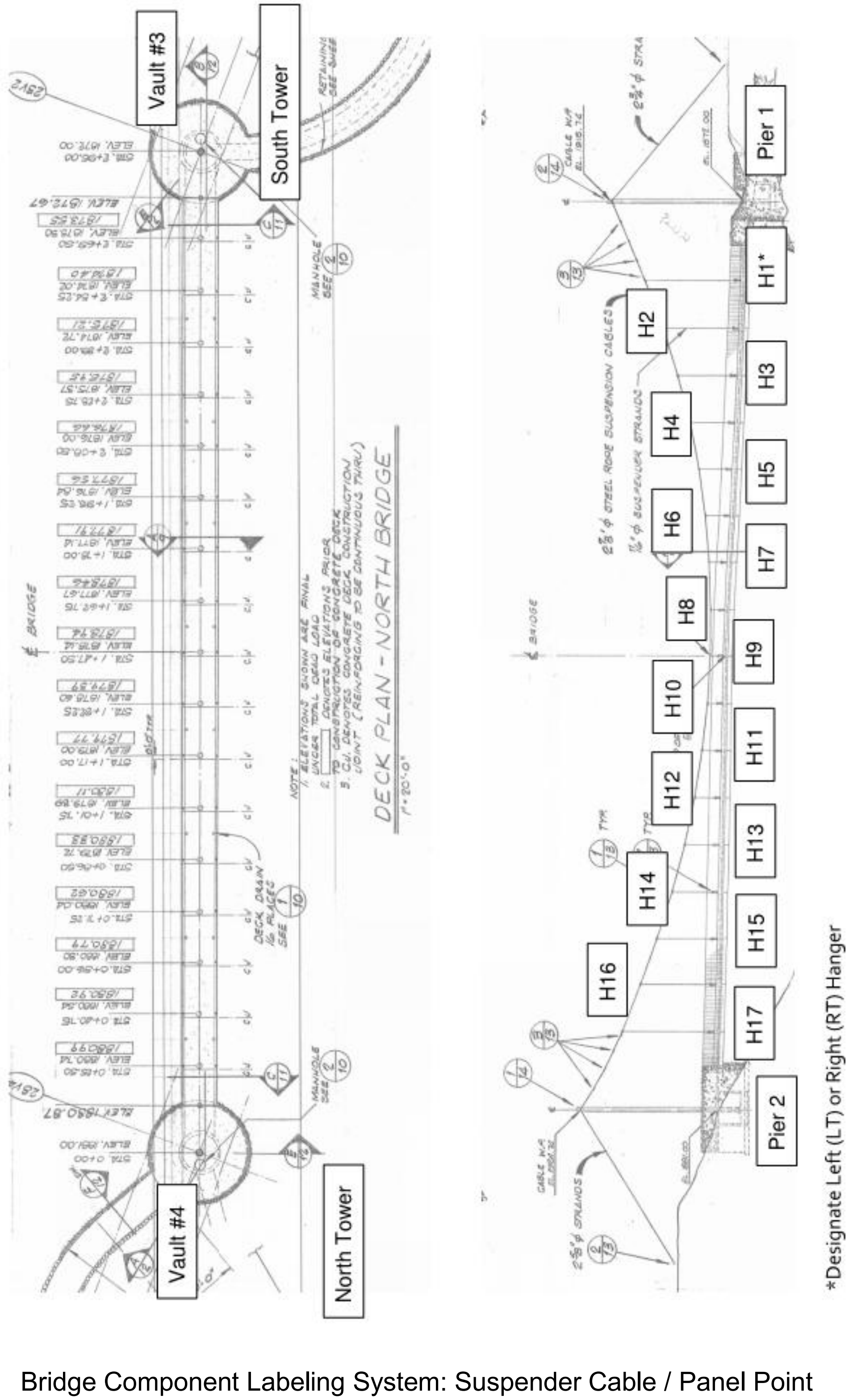
Photo 11 – Shrubs around Cable/Threaded Rod, Partially Buried Concrete Block

Photo 12 – Lock Nut at Southwest Anchorage is only 30% Engaged

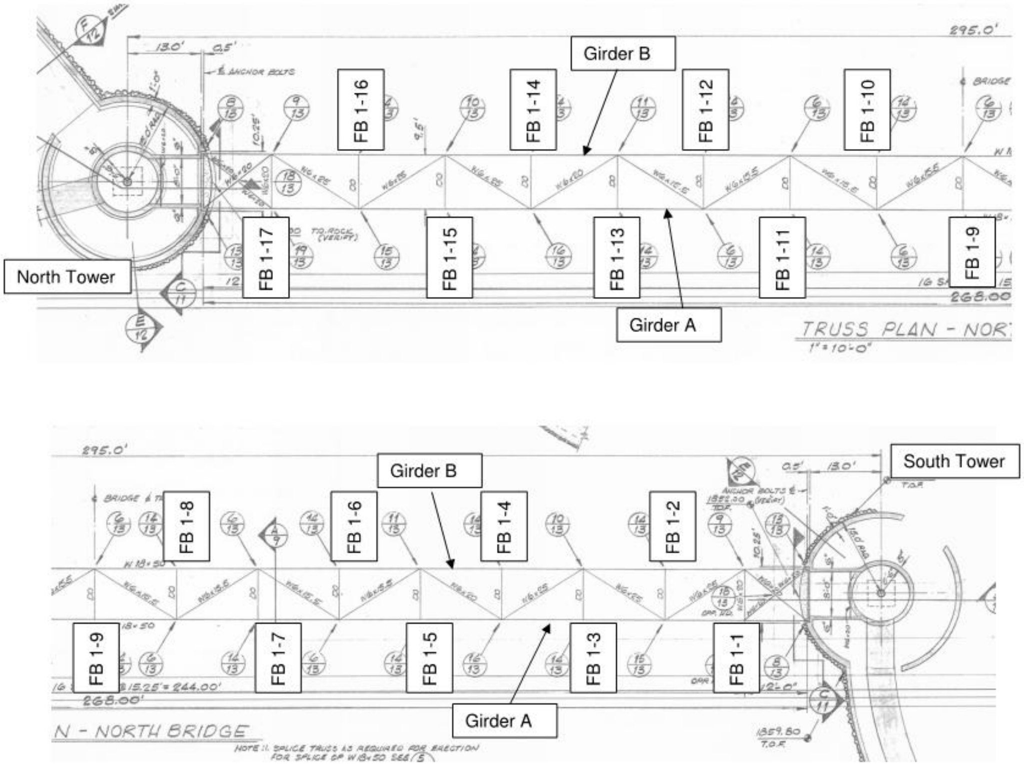
Photo 13 – Corroded/Missing Stay-in-Place Formwork above Floorbeam (Typical)

Photo 14 – Corroded/Missing Stay-in-Place Formwork and Corroded Beam/Angle in Vault No. 3 near Abutment

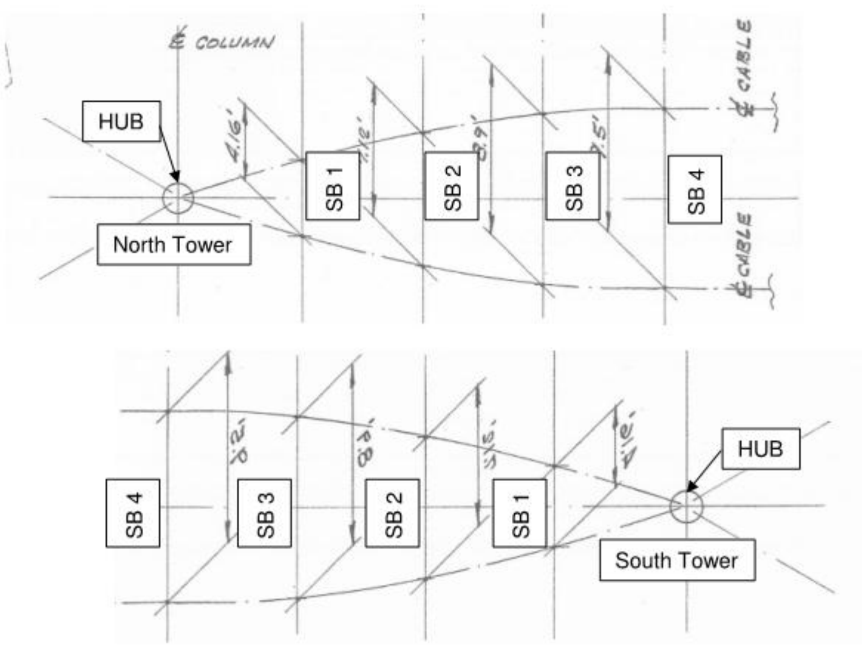
Photo 15 – Corroded Stay-in-Place Formwork around Manhole



Bridge Component Labeling System: Suspender Cable / Panel Point



Bridge Component Labelling System: Floorbeam



Bridge Component Labelling System: Spreader Bar

APPENDIX B

BRIDGE IMPROVEMENT DETAILS
COST ESTIMATES

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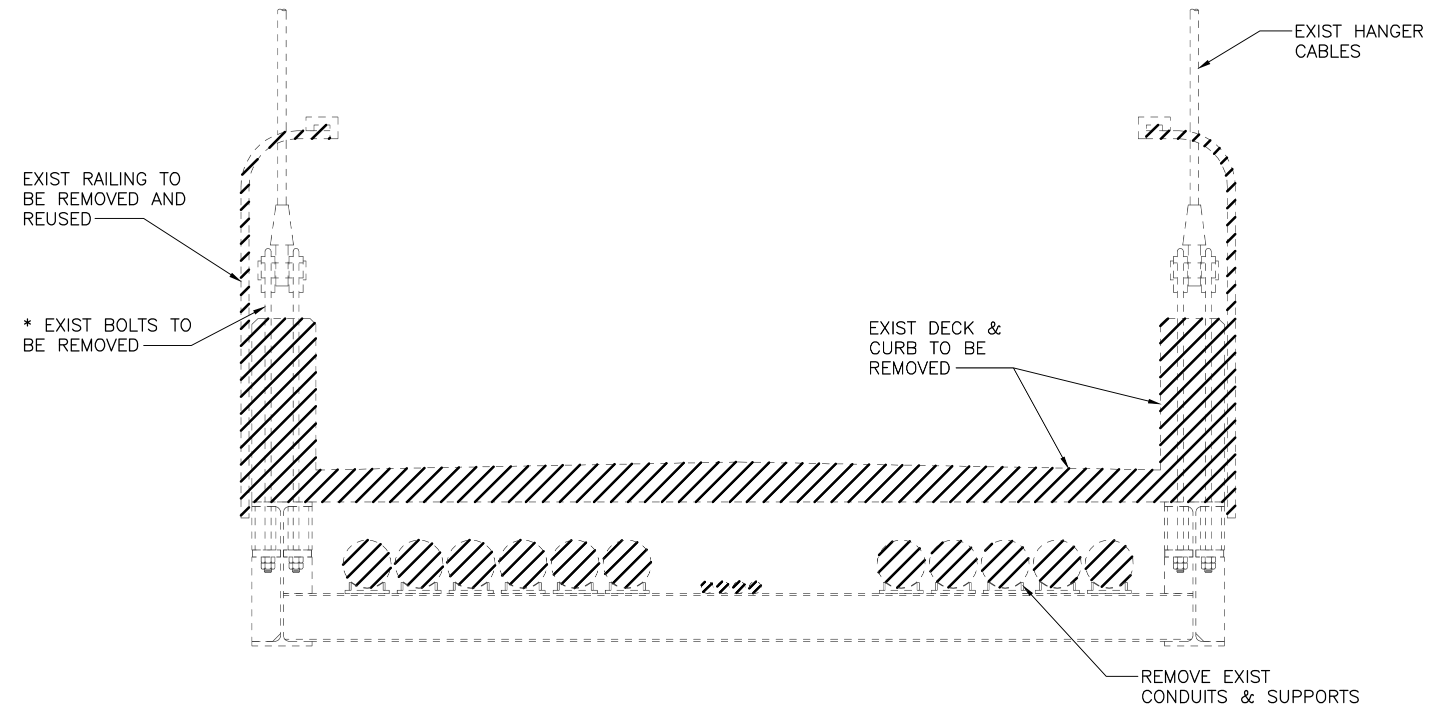
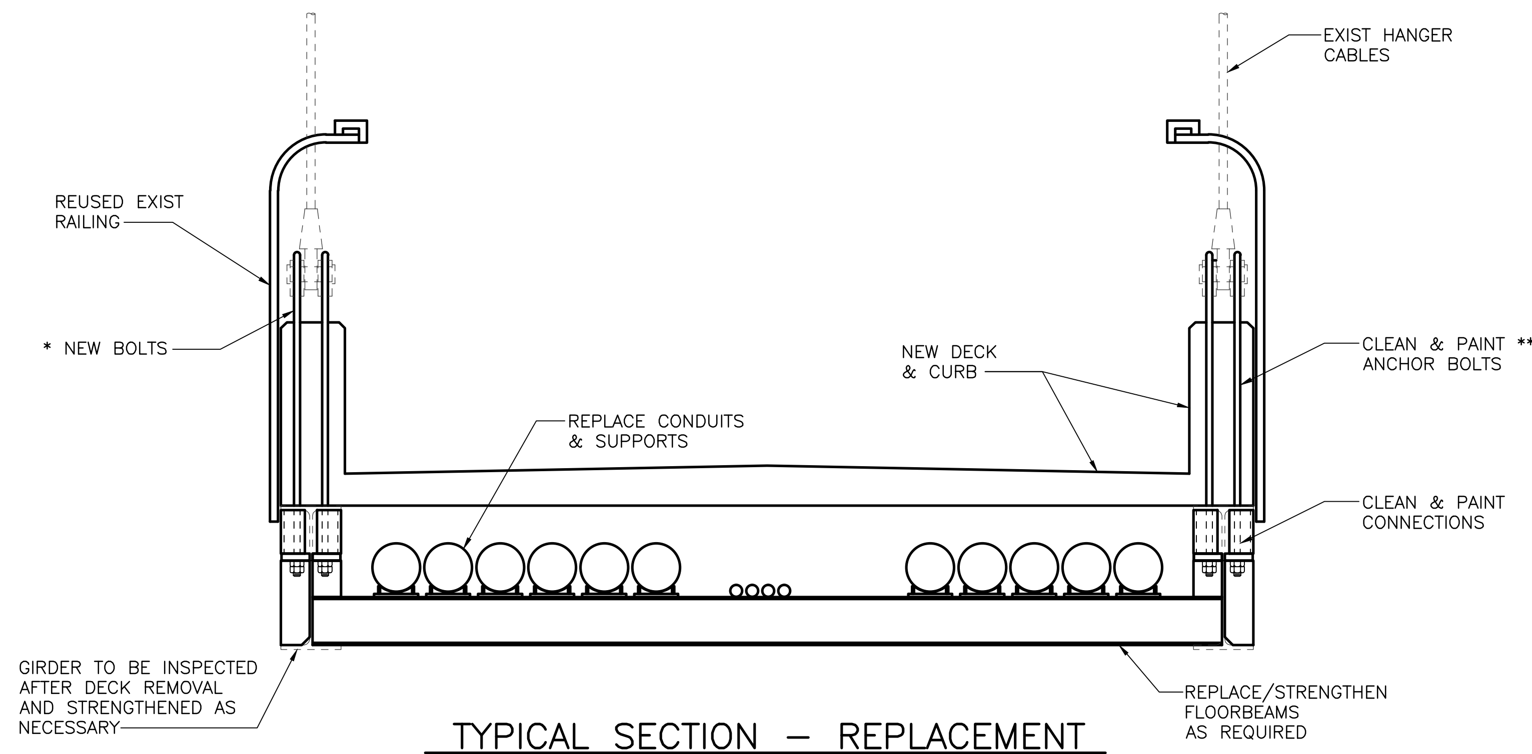
EASTERN	WASH.	---	



TYPICAL SECTION – REMOVAL

SCALE: 1" = 1'-0"



TYPICAL SECTION – REPLACEMENT

SCALE: 1" = 1'-0"

* EXISTING ANCHOR BOLTS WITH MORE THAN 25% SECTION LOSS SHALL BE REPLACED.

** EXISTING ANCHOR BOLTS WITH EQUAL OR LESS THAN 25% SECTION LOSS SHALL BE CLEANED AND PAINTED.

Name: TaunieA Date: Nov 11, 2014-11:47:56am File: V:\114176 (Spokane River Front Bridges)\Suspension Bridge\Design\SB-S01.dwg

REVISIONS (DATE | BY | PROJ. | DESCRIPTION)

AS BUILT (DATE | BY | PROJ. | E.P.N. | U.S.N. | FROM | TO | COUNCIL ACCEPT DATE)

GRADE ORDINANCE LIST (FROM | TO | ORD. NO. | DATE | FILE NO.)

NAVD88 = (OLD CBM ELEV.) - (13.13)

AS OF JANUARY, 2000 USE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

BENCH MARK LOCATION -

NAVD88 ELEV. -

CBM NO. -

NAVD88 DATUM

BAR IS ONE INCH ON ORIGINAL DRAWING.

IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

HORIZONTAL PLAN&PROFILE: AS SHOWN

VERTICAL PROFILE ONLY

SCALE

CURRENT C.O.S. DRAFTING STANDARDS ADOPTED FEB,2007

	BY	DATES
DRAWN:	HT	11/14
REVISED:	MLF	11/14
CHECKED:	TW	11/14
APPROVED:	MLF	11/14

CITY OF SPOKANE, WASHINGTON
DEPARTMENT OF ENGINEERING SERVICES
808 WEST SPOKANE FALLS BLVD.
SPOKANE, WASHINGTON 99201-3343
(509) 625-6700

PROJECT NAME: RIVERFRONT PARK BRIDGES

BRIDGE NAME: NORTH & SOUTH SUSPENSION BRIDGES
DECK REPLACEMENT & REHAB

TYPICAL SECTION

TYPE OF IMPROVEMENT: BRIDGE

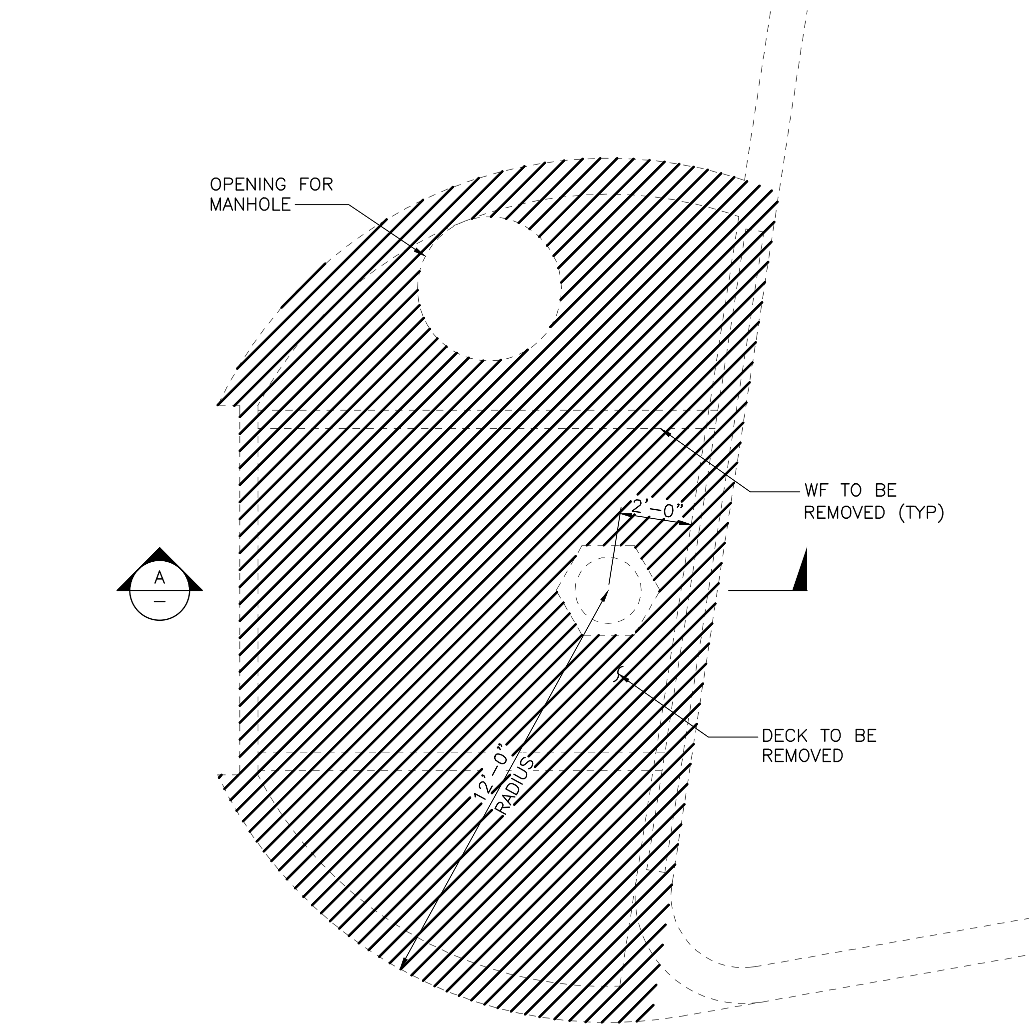
CITY PROJECT NUMBER: 2013186

EFN: --

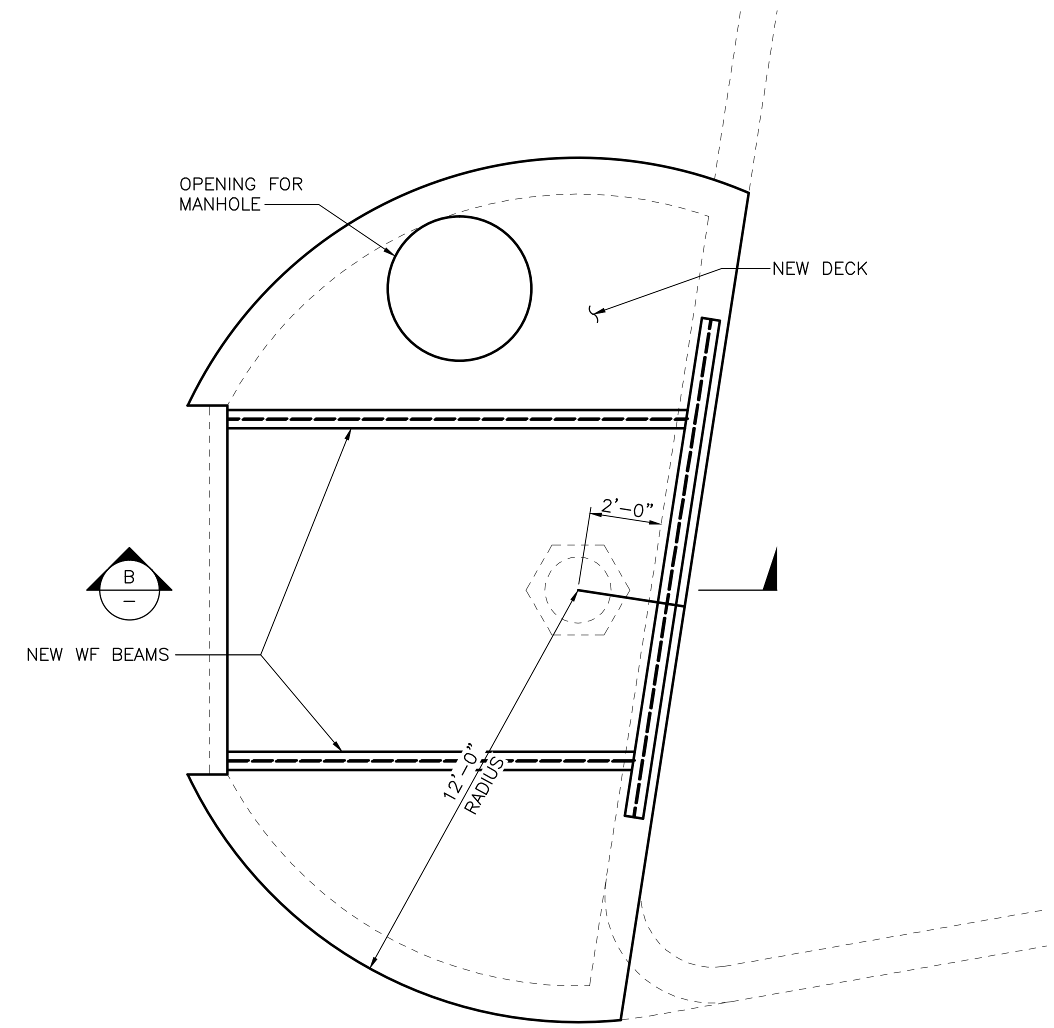
PLAN NUMBER: 1 of 3

CALL BEFORE YOU DIG 1-800-424-5555

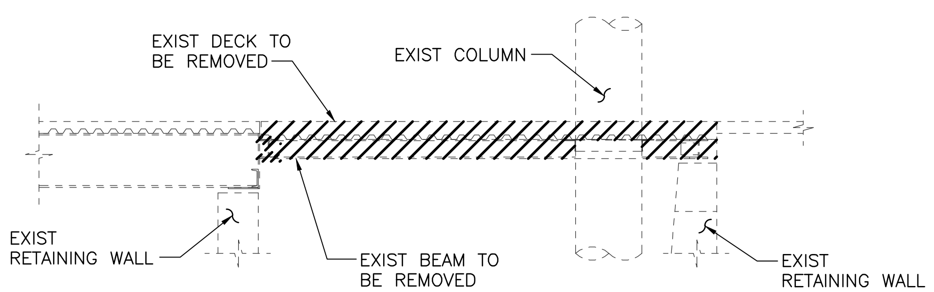
REGION NO.	STATE	FEDERAL AID PROJECT NO.	SHEET NO.
EASTERN	WASH.	---	



VAULT #1 – PLAN REMOVAL
SCALE: 3/8"=1'-0"



VAULT #1 – PLAN REPLACEMENT
SCALE: 3/8"=1'-0"



SECTION (A) REMOVAL
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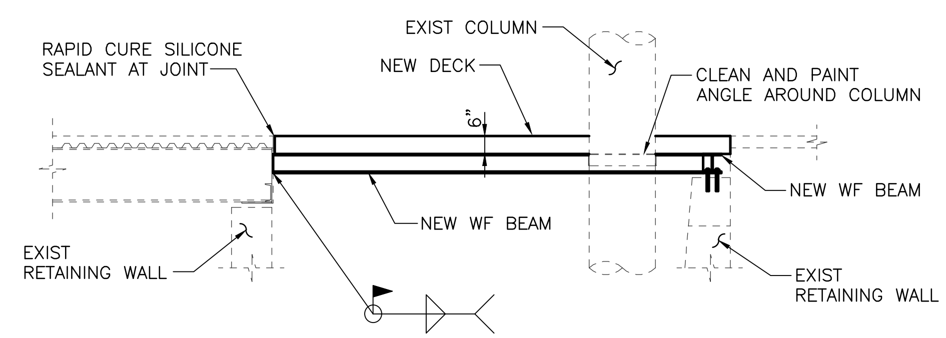

SECTION (B) REPLACEMENT
SCALE: 3/8"=1'-0"

DATE	BY	PROJ.	DESCRIPTION
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REVISIONS

DATE	BY	PROJ.	E.F.N.	U.S.N.	FROM	TO

AS BUILT

COUNCIL ACCEPT DATE	FROM	TO	ORD. NO.	DATE	FILE NO.

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NAVD88 ELEV. -
CBM NO. -
NAVD88 DATUM

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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

HORIZONTAL PLAN&PROFILE: AS SHOWN
VERTICAL PROFILE ONLY
SCALE

CURRENT C.O.S. DRAFTING STANDARDS ADOPTED FEB,2007

	BY	DATES
DRAWN:	HT	11/14
REVISED:	MLF	11/14
CHECKED:	TW	11/14
APPROVED:	MLF	11/14

CITY OF SPOKANE, WASHINGTON
DEPARTMENT OF ENGINEERING SERVICES
808 WEST SPOKANE FALLS BLVD.
SPOKANE, WASHINGTON 99201-3343
(509) 625-6700

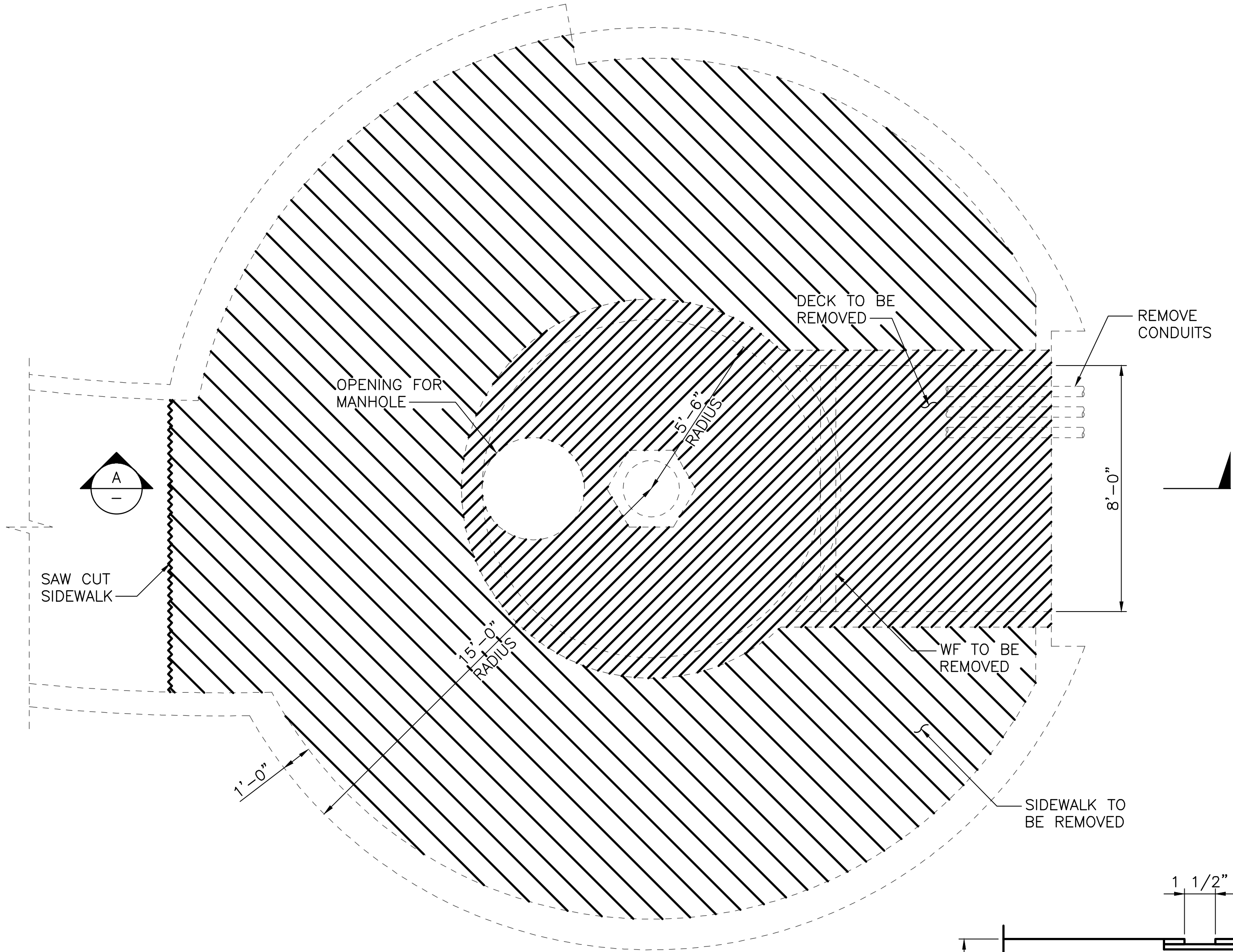
PROJECT NAME: RIVERFRONT PARK BRIDGES
BRIDGE NAME: NORTH & SOUTH SUSPENSION BRIDGES
VAULT DECK REPLACEMENT
PLAN AND SECTION

TYPE OF IMPROVEMENT: BRIDGE
CITY PROJECT NUMBER: 2013186
EFN: --
PLAN NUMBER: 2 of 3

CALL BEFORE YOU DIG 1-800-424-5555

Name: TaunieA Date: Nov 11, 2014-11:47:45am File: V:\114176 (Spokane River Front Bridges)\Suspension Bridge\Design\SB-S02.dwg

REGION NO.	STATE	FEDERAL AID PROJECT NO.	SHEET NO.
EASTERN	WASH.	---	



VAULT #2, 3, 4 – PLAN REMOVAL

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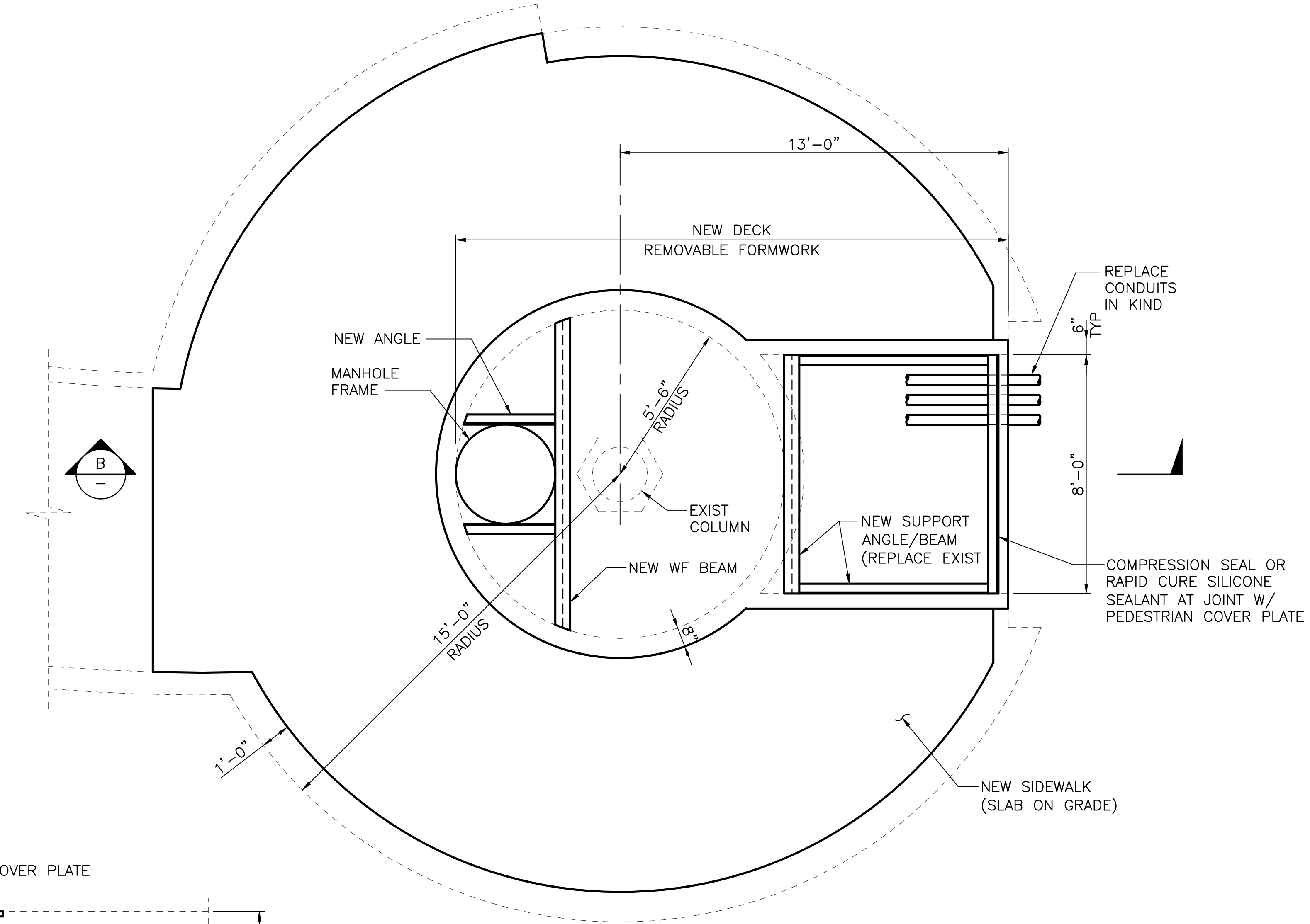
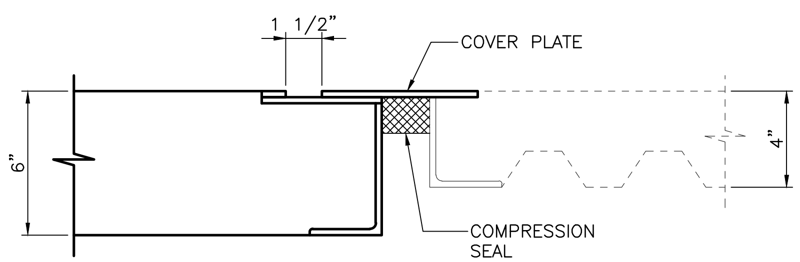


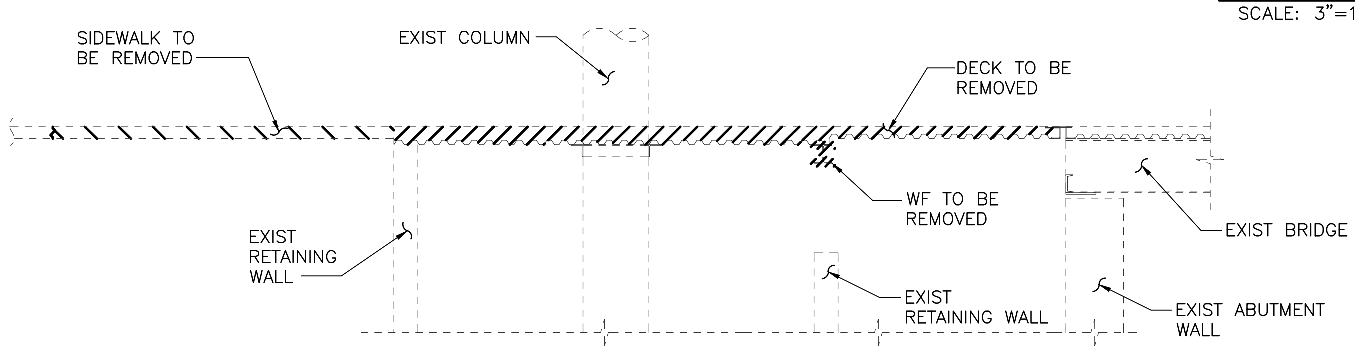


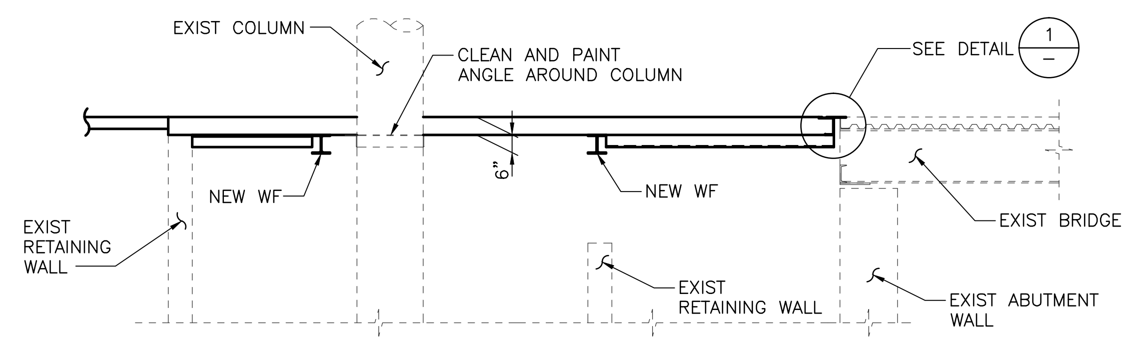
VAULT #2, 3, 4 – PLAN REPLACEMENT

SCALE: 3/8"=1'-0"

DETAIL 1

SCALE: 3"=1'-0"





SECTION A REMOVAL

SCALE: 3/8"=1'-0"

SECTION B REPLACEMENT

SCALE: 3/8"=1'-0"

Name: TaunieA Date: Nov 11, 2014–11:48:24am File: V:\114176 (Spokane River Front Bridges)\Suspension Bridge\Design\SB-S03.dwg

DATE	BY	PROJ.	DESCRIPTION
REVISIONS			

DATE	BY	PROJ.	E.P.N.	U.S.N.	FROM	TO	COUNCIL ACCEPT DATE
AS BUILT							

FROM	TO	ORD. NO.	DATE	FILE NO.
GRADE ORDINANCE LIST				

NAVD88 DATUM

BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

HORIZONTAL PLAN/PROFILE AS SHOWN; VERTICAL PROFILE ONLY

SCALE

CURRENT C.O.S. DRAFTING STANDARDS ADOPTED FEB.2007

	BY	DATES
DRAWN:	HT	11/14
REVISED:	MLF	11/14
CHECKED:	TW	11/14
APPROVED:	MLF	11/14

CITY OF SPOKANE, WASHINGTON
DEPARTMENT OF ENGINEERING SERVICES
808 WEST SPOKANE FALLS BLVD.
SPOKANE, WASHINGTON 99201-3343
(509) 625-6700

PROJECT NAME: RIVERFRONT PARK BRIDGES

BRIDGE NAME: NORTH & SOUTH SUSPENSION BRIDGES
VAULT DECK REPLACEMENT

PLAN AND SECTION

TYPE OF IMPROVEMENT: BRIDGE

CITY PROJECT NUMBER: 2013186

PLAN NUMBER: 3 of 3

CALL BEFORE YOU DIG 1-800-424-5555

City of Spokane Pedestrian Bridges Nov-14

Cost Estimates for Bridge Improvements Based on the 2014 KPFF Inspection and Analysis Recommendations

Bridge Name: Two Suspension Bridges (North and South) and Vault decks.

Combined Bridge Length and Width (feet) 474 10

Recommendations for Improvements - Include: Deck Replacement, Structural Steel Improvments, Valult Rehabilitation

Item no	Item Description	Cost Unit	Quantity	Unit Cost		Item Cost
1	Existing Rail Remove and Re-install	LF	474	90	$	42,660
2	Replace Existing Anchor Bolts	EA	25	1250	$	31,000
3	Clean and Paint In-situ Anchor Bolts	EA	223	450	$	100,440
4	Remove Existing Deck and Curb	SF	4740	45	$	213,300
5	New Deck and Curb	SF	4740	65	$	308,100
6	Replace Floorbeams	EA	9	4500	$	38,925
7	Clean, Strengthen, & Paint in-situ Floorbeams	EA	26	1500	$	39,525
8	Replace Conduits and Supports	LF	7110	12	$	85,320
9	Edge Girder Repair and Painting	LF	948	250	$	237,000
10	Repair/Replace Vault Deck and Adj. Sidewalk	EA	4	25000	$	100,000
12	Misc and Constructibility Access	LS	2	100000	$	200,000
	Total				$	1,396,270
13	Mobilization	12%			$	167,552
14	Design, Permits, Survey	30%			$	418,881
15	Construction Management	13%			$	174,534
16	Taxes	8%			$	111,702
17	Contingency	30%			$	418,881
18	Excalation (1 year)	3%			$	41,888
19	Agency Project Development & Mngmt.	5%			$	69,814
	Total				$	1,403,251
	Total Project Cost (2015)				**$**	**2,799,521**
	Square Foot Cost - includes Vault Area ($/SF)				$	545

Note: Total project cost is for both north and south suspension bridges and all four vault repairs.

APPENDIX C

LOAD RATING RESULTS AND CALCULATIONS

Structural Analysis –
Load Rating Summary

LRFR Bridge Rating Summary

Strength I – Rating Factors (RF):

	Pedestrian		Vehicle	
	Inventory	**Operating**	**Inventory**	**Operating**
Deck (Stress) RF	**0.51**	**0.66**	*N/A*	*N/A*
Controlling Point	Center of Deck		*N/A*	
Steel (Moment) RF	3.30	4.28	**1.45**	**1.88**
Controlling Point	Girders at Hanger Connections		Girders at Hanger Connections	
Cable (Axial) RF	1.08	1.40	7.38	9.57
Controlling Point	Backstay Cables		Backstay Cables	
Pylon (M+A) RF	1.73	2.24	12.8	16.6
Controlling Point	Base of Pylon		Base of Pylon	

Maximum Pedestrian Live Load

Inventory = 0.51*90 psf = 46 psf
Operating = 0.66*90 psf = 59 psf

Pedestrian = 90 psf uniform distributed load

Vehicle = Bridge Inspection Vehicles

(12,150 lb. front axle, 4,050 lb. rear axle, 6'-7" axle spacing)
(15,895 lb. front axle, 5,300 lb. rear axle, 8'-3" axle spacing)
Weights provided by City of Spokane Engineering Department

Figures C3.1-1 and C3.1-2 from the *LRFD Guide Specifications for the Design of Pedestrian Bridges* (December 2009) give a visual representation of the uniform pedestrian live load.

Figure C3.1-1—Live Load of 50 psf

Figure C3.1-2—Live Load of 100 psf

Structural Analysis - Load Rating

Design Parameters:

Concrete
f'c = 4,000 psi @ 28 days
Rebar – fy = 60,000 psi

Steel
Yield Stress, fy = 50 ksi
Modulus of Elasticity, E = 29,000 ksi

Cables
Yield Stress, fy = 160 ksi
Tensile Stress, fu = 200 ksi
Modulus of Elasticity, E = 20,000 ksi

Dead Loads
Superstructure self weight
Curb and railing
Conduits
(CSiBridge Load – Sched3-ZERO, step 31)

Live Loads
Pedestrian Uniform Load = 90 psf
(CSiBridge Load – Pedestrian)
Vehicle Load = 16,200 lb inspection vehicle
(CSiBridge Load – Truck 1)
Vehicle Load = 21,190 lb inspection vehicle
(CSiBridge Load – Truck 2)
Impact is not included
Pedestrian and Vehicle Loads do not act concurrently

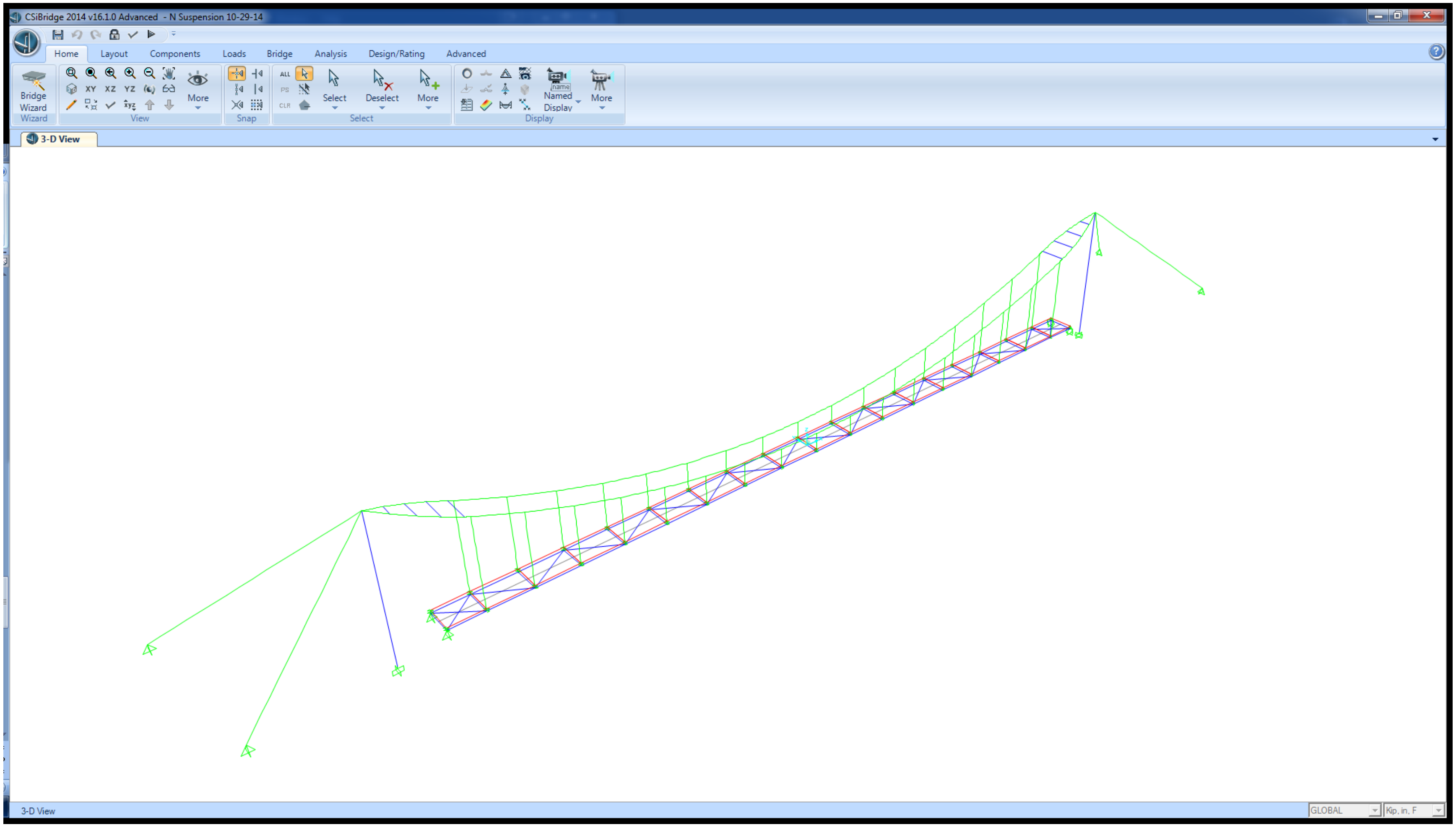
Analysis Methods:

The bridge geometry, section properties, and cables were modeled in CSiBridge based on the "As Built" drawings. The force in the cables was not specified so they were set to values that resulted in zero dead load deflection. The moment, shear, and axial demands due to dead loads and live loads were exported from CSiBridge to Excel. The moment, shear, and axial capacities were calculated in Excel. The Strength I rating factors were calculated in Excel using the peak demands in each element type.

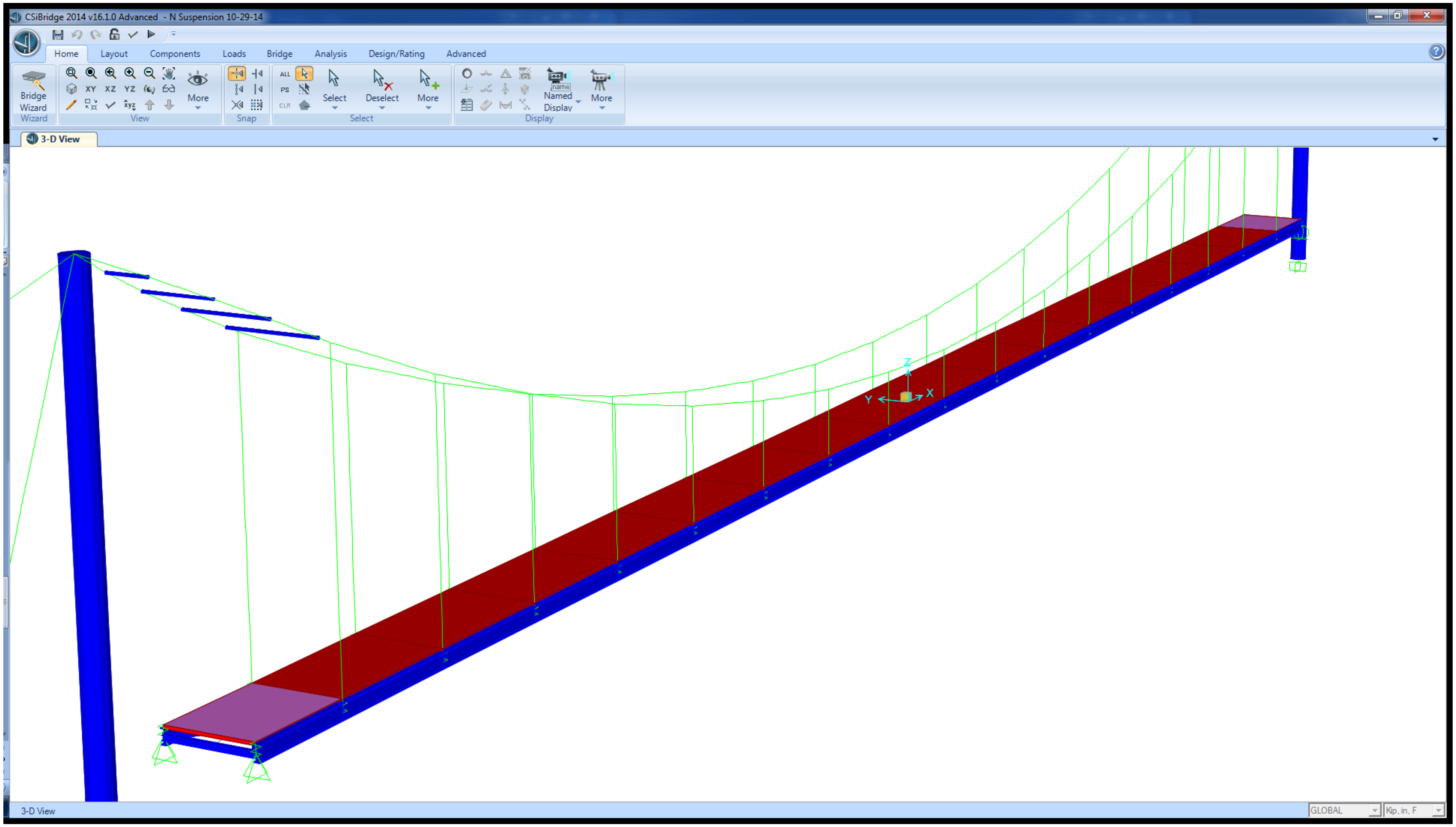
The visual bridge inspection completed on September 5, 2014 found the deck to be in poor condition, and the floor beams to be in fair condition. All other superstructure components were shown to be in good condition. The condition rating factor, φ_c, is equal to 1.0 for good members, 0.95 for fair members, and 0.85 for poor members. The system rating factor, φ_s is equal to 1.0 for redundant members such as the deck, floorbeams, crossbracing, and spreader bars, and 0.85 for all other non redundant members.

The Strength I Load Rating checks flexure, shear, and axial capacities, as well as combined concurrent moment and axial capacity. Each member was checked individually and compared to the demands given in the CSiBridge model. The deck was not load rated for vehicles as it is in poor condition and is being recommended for replacement. No vehicles shall be allowed on the existing deck.

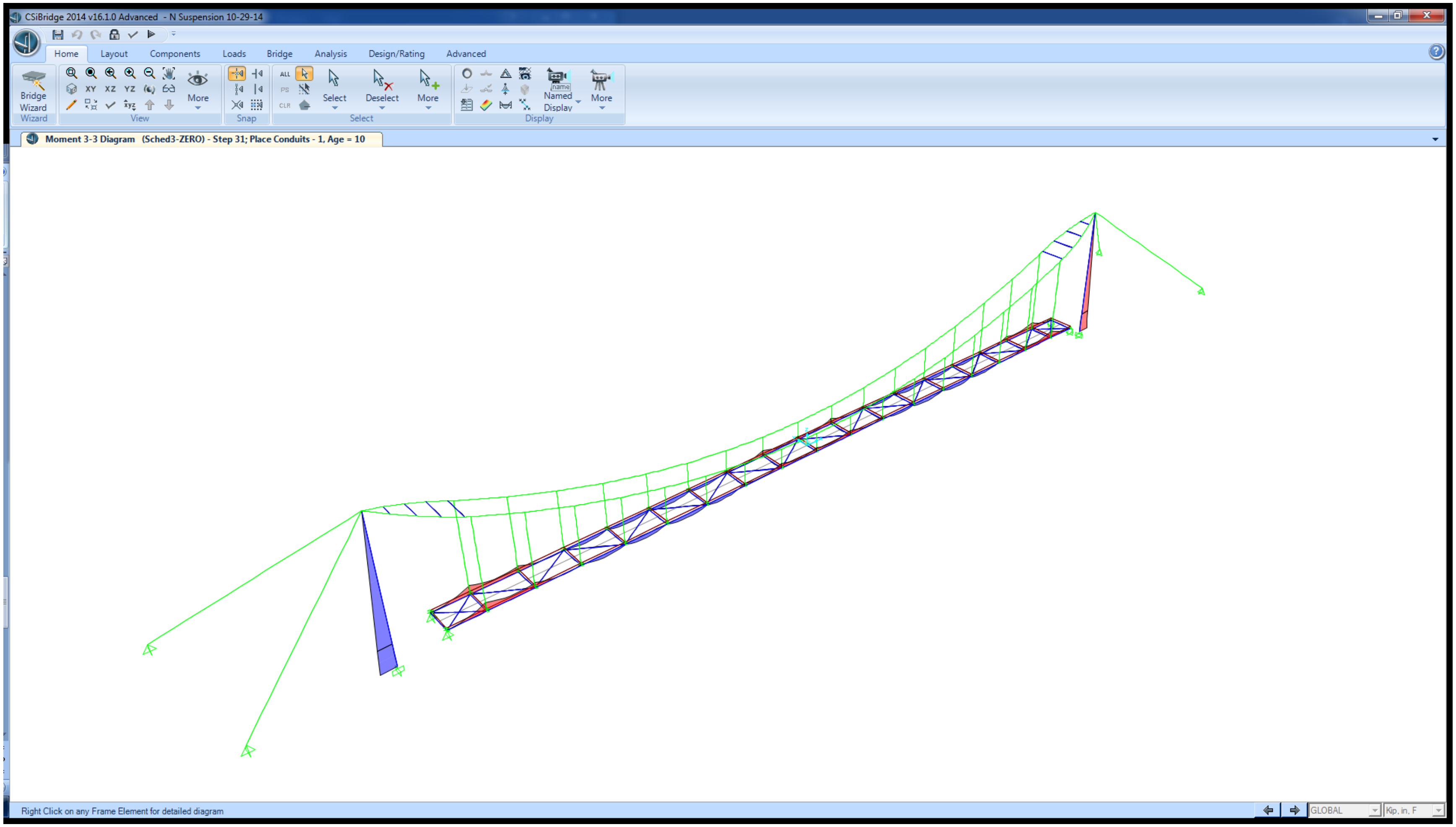
North Suspension Bridge Undeformed



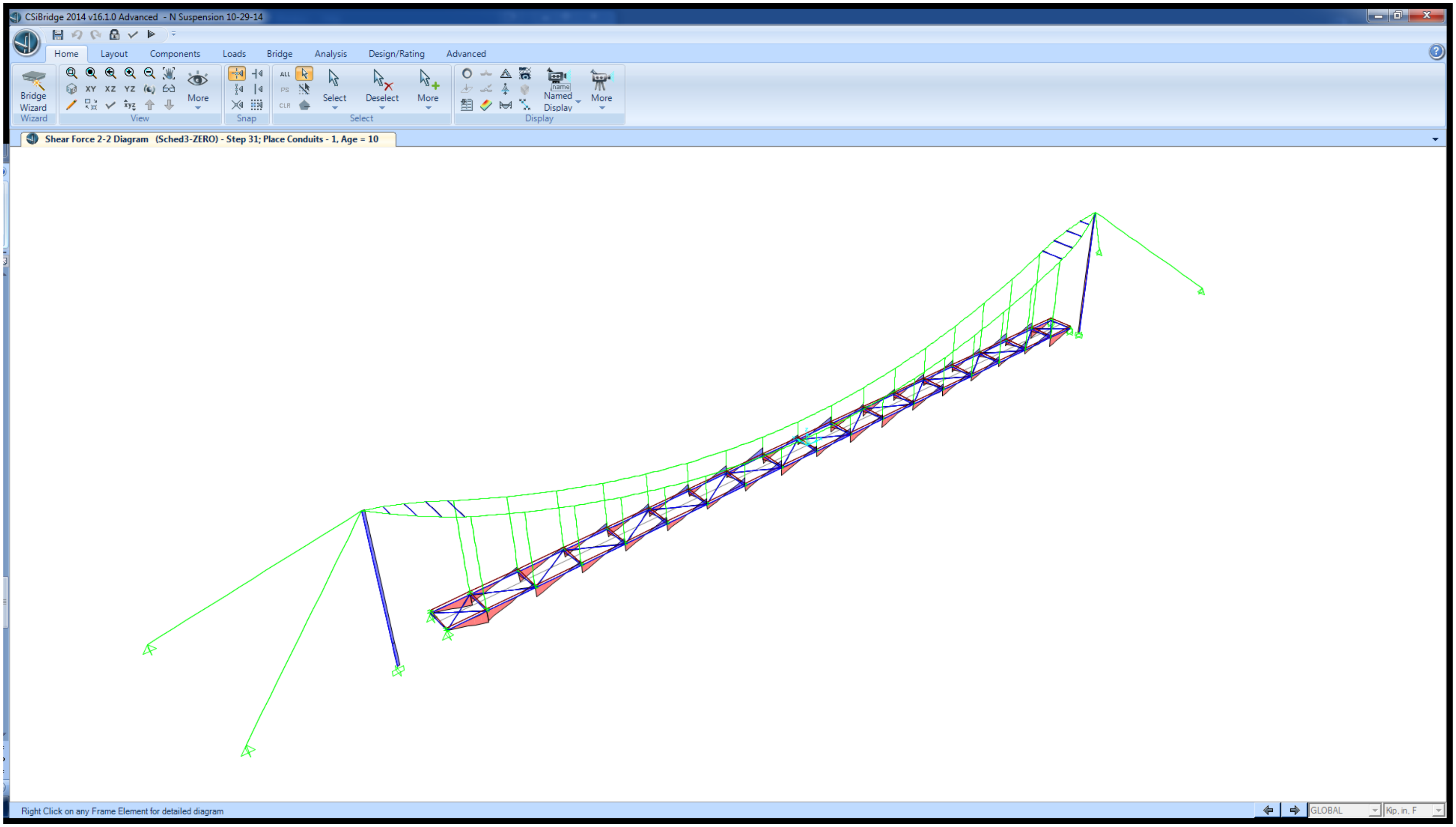
North Suspension Bridge Extruded View



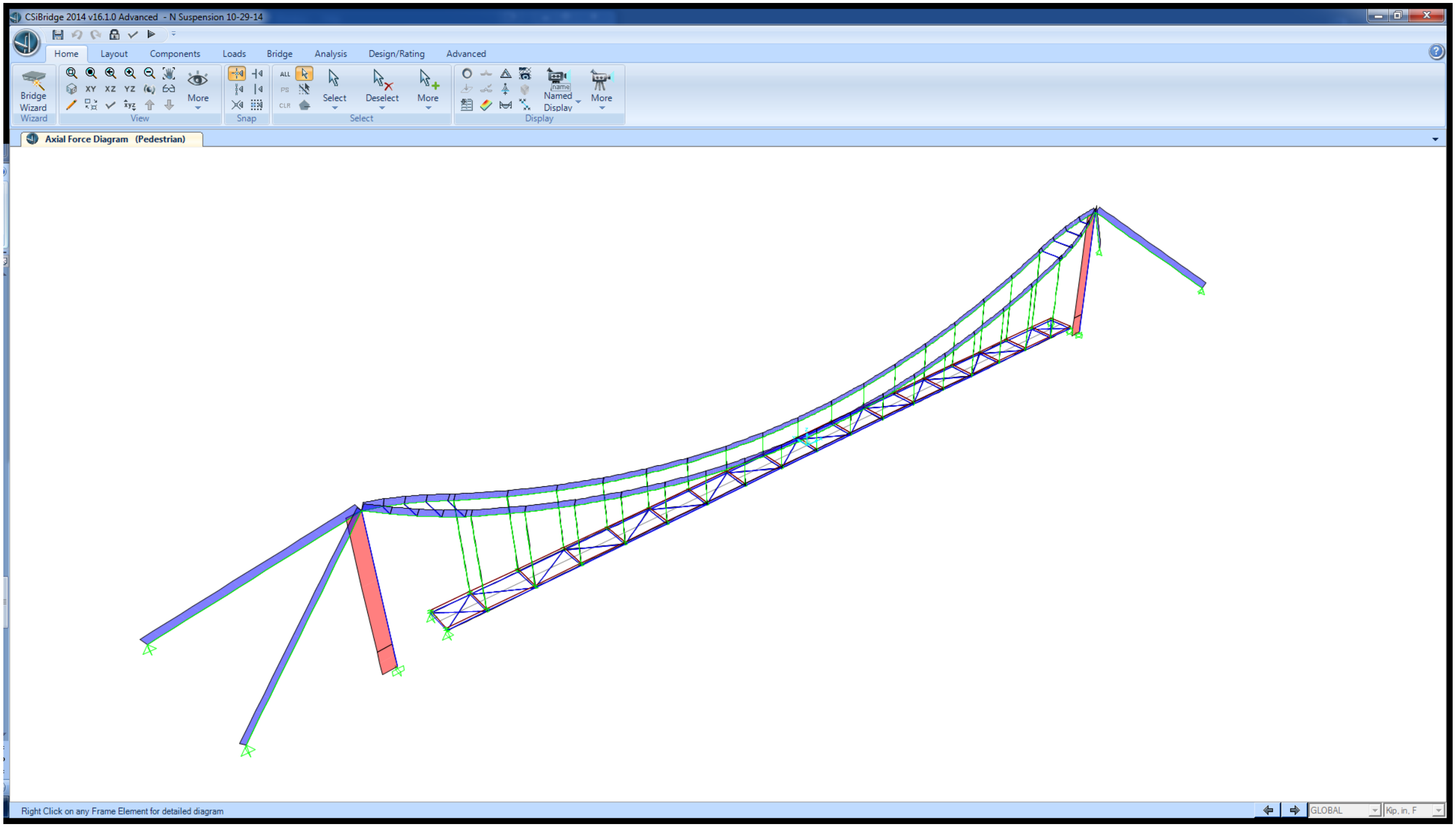
North Suspension Bridge Dead Load Moment



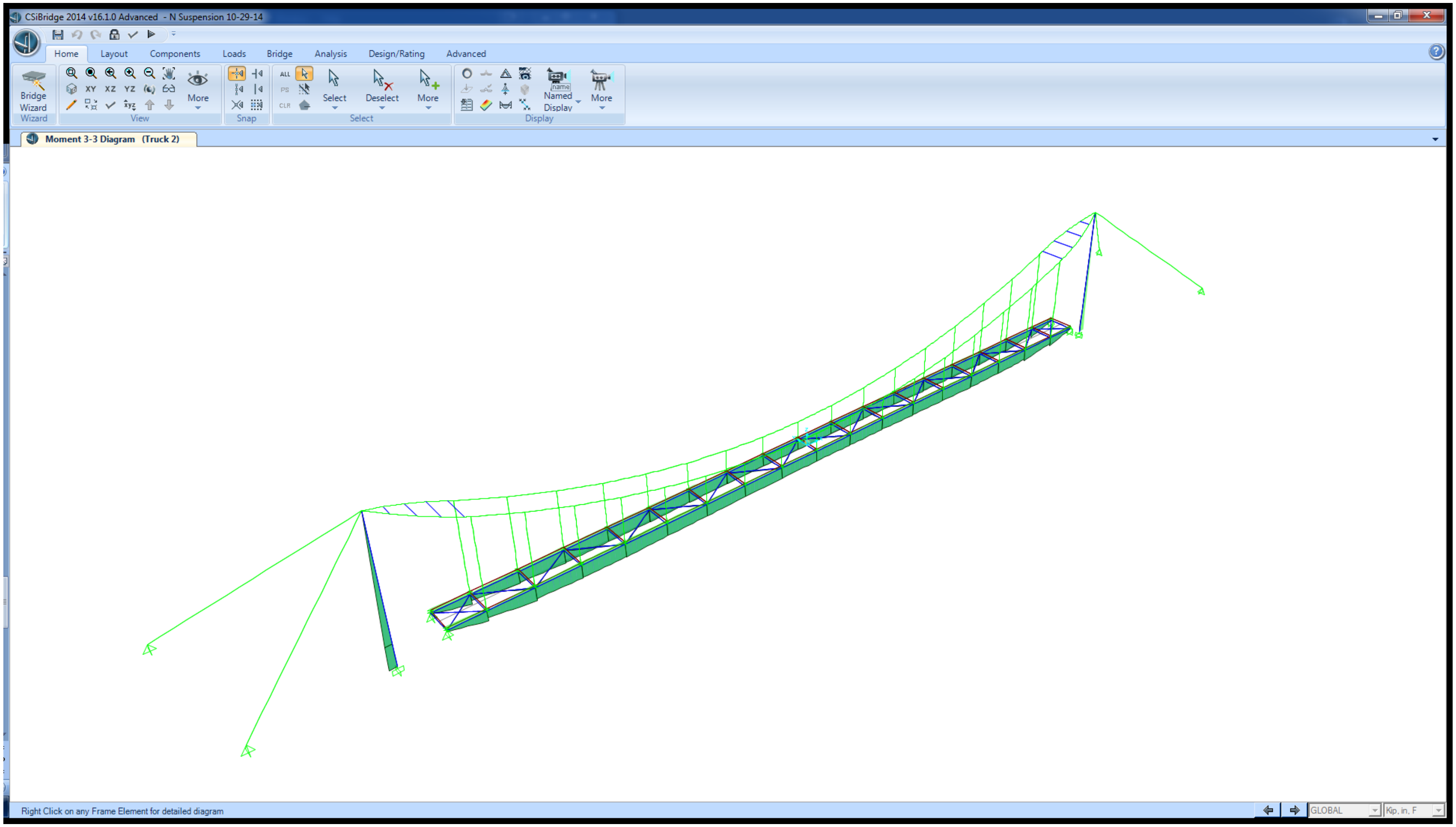
North Suspension Bridge Dead Load Shear



North Suspension Bridge Pedestrian Axial Force



North Suspension Bridge Vehicular Moment



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North Suspension Bridge Load Rating (LRFR Method)

Concrete Deck

t_{middle}	5	*in*
t_{edges}	4	*in*
$h_{corregation}$	1.5	*in*
$t_{average}$	3.75	*in*
clear cov.	1.5	*in*
$d_{trans.\ bars}$	1.75	*in*
A_{bars}	0.2	in^2
s_{bars}	9	*in*
f_y	60	*ksi*
w_{deck}	8.79	*ft*
S	28.1	in^3/ft
f'_c	4	*ksi*
γ_c	0.16	*kcf*
β_1	0.85	

**Conservatively neglect corregated metal formwork and strength of concrete in corregation. Since the transverse steel is so high up in the section, check the bending stress in the bottom of the slab at the middle instead of the moment. The deck is assumed to be between fixed-fixed and pinned-pinned at the curbs. Curbs not checked.*

Dead Loads Self Weight of deck is only dead load

Weight	$W_{deck} = t_{average} * \gamma_c * 1\ ft$ =	50.0	*lb/ft*
Moment	$M_{deck\ fixed} = W_{deck} * b_{deck}^2/24$ =	161	*lb-ft/ft*
	$M_{deck\ pinned} = W_{deck} * b_{deck}^2/8$ =	483	*lb-ft/ft*
Bot. Stress	$\sigma_{deck} = M_{deck\ avg.}/S$ =	137	*psi*
Shear	$V_{deck} = W_{deck} * b_{deck}/2$ =	220	*lb/ft*

Live Loads Pedestrian and Vehicular loads act seperately

<u>*Pedestrian:*</u> PL 90 *psf* AASHTO LRFD Ped Bridge 3.1

Weight	$W_{PL} = PL * 1\ ft$ =	90	*lb/ft*
Moment	$M_{deck\ fixed} = W_{PL} * b_{deck}^2/24$ =	290	*lb-ft/ft*
	$M_{deck\ pinned} = W_{PL} * b_{deck}^2/8$ =	870	*lb-ft/ft*
Bot. Stress	$\sigma_{PL} = M_{PL\ avg.}/S$ =	247	*psi*
Shear	$V_{PL} = W_{PL} * b_{deck}/2$ =	396	*lb/ft*

<u>*Vehicular:*</u>

	LL	Truck 1	Truck 2	
Weight	Total	16.2	21.19	*k*
	Axle 1 Wheels	6.08	7.95	*k*
	Axle 2 Wheels	2.03	2.65	*k*
	wheel spacing	6	6	*ft*
	axle spacing	6.58	8.25	*ft*

Moment	M_{LL} =	*N/A*	*lb-ft/ft*
Shear	V_{LL} =	*N/A*	*lb/ft*

Vehicular demands not checked as vehicles are not allowed on bridge.

Capacity

Shear

$V_n = V_c + V_s$ AASHTO 5.8.3.3-1

Φ 0.9 AASHTO 5.5.4.2

$V_c = 0.0316*\beta*\sqrt{(f'_c)}*b_v d_v$ AASHTO 5.8.3.3-3

β 2 AASHTO 5.8.3.4.1

b_v 12 *in* (Unit width)

$d_v = M_n/(A_s f_y) < \min(0.9d, 0.72h)$ AASHTO 5.8.2.9

$d_v =$ 1.80 *in*

$V_c =$ 2730 *lb/ft*

$V_s = 0$ (Conservative assumption)

$\Phi V_n =$ 2730 *lb/ft*

Direct Concrete Tensile Strength

$f_r = 0.23*\sqrt{f'_c} =$ 0.46 *ksi* AASHTO C5.4.2.7

Rating Factors

$$RF = \frac{(C - \gamma_{DC}DC - \gamma_{DW}DW +/- \gamma_P P)}{\gamma_{LL}LL(1+IM)}$$ AASHTO MBE 6A.4.2.1-1

$C_{Str-I} = \Phi_c\Phi_s\Phi_n R_n$ AASHTO MBE 6A.4.2.1-2

$\Phi_c\Phi_s \geq 0.85$ AASHTO MBE 6A.4.2.1-3

Φ_s 1 AASHTO MBE 6A.4.2.4

γ_{DC} 1.25

$\gamma_{LL\ inv.}$ 1.75

$\gamma_{LL\ op.}$ 1.35

IM 0 AASHTO LRFD Ped. Bridge Manual 3.2

Bottom Stress

Condition	Good	Fair	Poor
Φ_c	1	0.95	0.85
C [psi]	460	437	391
$RF_{pedestrian\ inventory}$	**0.67**	**0.61**	**0.51**
$RF_{pedestrian\ operating}$	**0.86**	**0.79**	**0.66**
$RF_{vehicle\ inventory}$	**N/A**	**N/A**	**N/A**
$RF_{vehicle\ operating}$	**N/A**	**N/A**	**N/A**

Shear

Condition	Good	Fair	Poor
Φ_c	1	0.95	0.85
C [lb/ft]	2730	2594	2321
$RF_{pedestrian\ inventory}$	**3.55**	**3.35**	**2.96**
$RF_{pedestrian\ operating}$	**4.60**	**4.34**	**3.83**
$RF_{vehicle\ inventory}$	**N/A**	**N/A**	**N/A**
$RF_{vehicle\ operating}$	**N/A**	**N/A**	**N/A**

kpff Consulting Engineers

North Suspension Bridge Load Rating (LRFR Method)

Girders

L	268	*ft*
Spacing	9.5	*ft*
Crossbeam Spacing	15.25	*ft*

Size W18x50

b_f	7.50	*in*	F_{yc}	50	*ksi*
t_f	0.570	*in*	F_{yw}	50	*ksi*
r_t	1.98	*in*	$F_{yr} = 0.7F_{yc}$	35	*ksi*
d	18	*in*	E	29000	*ksi*
D	16.9	*in*			
t_w	0.355	*in*			
S_x	88.9	in^3			

Dead Loads

Moment	M_{max}	(+)	87.6	*k-in*	
	M_{min}	(-)	202.4	*k-in*	(from CSiBridge Model)
Shear	V_{max}		2.48	*k*	

Live Loads Pedestrian and Vehicular loads act seperately

Pedestrian: PL 90 *psf* AASHTO LRFD Ped Bridge 3.1

Weight $W_{PL} = PL*w_{trib.} =$ 427.5 *plf*

Moment	M_{max}	(+)	431.2	*k-in*	
	M_{min}	(-)	226.0	*k-in*	(from CSiBridge Model)
Shear	V_{max}		2.15	*k*	

Vehicular:

	LL	Truck 1	Truck 2	
Weight	Total	16.2	21.19	*k*
	Axle 1 Wheels	6.08	7.95	*k*
	Axle 2 Wheels	2.03	2.65	*k*
	wheel spacing	6	6	*ft*
	axle spacing	6.58	8.25	*ft*

Moment	M_{max}	(+)	1016	*k-in*	(From CSiBridge Model, Truck 2 controls)
	M_{min}	(-)	305.0	*k-in*	
Shear	V_{max}		7.47	*k*	

Capacity

Local Buckling Resistance — AASHTO 6.10.8.2.2

$\lambda_f = b_{fc}/2t_{fc}$ =	6.58	AASHTO 6.10.8.2.2-3
$\lambda_{pf} = 0.38*\sqrt{(E/F_{yc})}$ =	9.15	AASHTO 6.10.8.2.2-4
$\lambda_{rf} = 0.56*\sqrt{(E/F_{yr})}$ =	13.49	AASHTO 6.10.8.2.2-5

$\lambda_f < \lambda_{pf} \rightarrow$ $F_{nc} = R_b*R_h*F_{yc}$ — AASHTO 6.10.8.2.2-1

R_b	1	AASHTO 6.10.1.10.2
R_h	1	AASHTO 6.10.1.10.1 (constructability is not checked)

F_{nc} = 50 *ksi*

Lateral Torsional Buckling — AASHTO 6.10.8.2.3

L_b	15.25 *ft*	
$L_p = r_t*\sqrt{(E/F_{yc})}$ =	3.97 *ft*	AASHTO 6.10.8.2.3-4
$L_r = \pi*r_t*\sqrt{(E/F_{yr})}$ =	14.92 *ft*	AASHTO 6.10.8.2.3-5

$L_b > L_r \rightarrow$ $F_{nc} = F_{cr} \le R_b*R_h*F_{yc}$

$$F_{cr} = \frac{C_b*R_b*\pi^2*E}{(L_b/r_t)^2}$$ AASHTO 6.10.8.2.3-9

$C_b = 1.75 - 1.05(M_1/M_2) + 0.3(M_1/M_2)^2 \le 2.3$ — AASHTO 6.10.8.2.3-7

	(-M)	(+M)		
$M_{2\ (veh.)}$ =	-305.0	1016	*k-in*	largest moment at end of braced length
$M_{mid\ (veh.)}$=	-269.5	760	*k-in*	moment at middle of braced length
$M_{0\ (veh.)}$ =	-234.1	504	*k-in*	smallest moment at end of braced length
$M_{1\ (veh.)} = M_{0\ (veh.)}$ =				AASTHO A6.3.3-12
	-234.1	504	*k-in*	
$C_{b\ (vehicle)}$ =	1.12	1.30		

	(-M)	(+M)		
$M_{2\ (ped.)}$ =	-226.0	431.2	*k-in*	largest moment at end of braced length
$M_{mid\ (ped.)}$=	-31.2	407.1	*k-in*	moment at middle of braced length
$M_{0\ (ped.)}$ =	163.7	383.1	*k-in*	smallest moment at end of braced length
$M_{1\ (ped.)} = M_{0\ (ped.)}$ =				AASTHO A6.3.3-12
	163.7	383.1	*k-in*	
$C_{b\ (ped.)}$ =	2.30	1.03		

	(-M)	(+M)	
$F_{cr\ (vehicle)}$ =	37.6	43.7	*ksi*
$F_{cr\ (ped.)}$ =	77.1	34.4	*ksi*

$F_{nc\ veh.\ \&\ -ped}$ = 37.6 *ksi*

$F_{nc\ +ped}$ = 34.4 *ksi*

Tension Flange Flexural Resistance

$F_{nt} = R_h * F_{yt} =$ 50 *ksi* AASHTO 6.10.8.3-1

Minimum Flexural Resistance

$\Phi M_{n\,33} = \Phi_f * S_x * \min(F_{nc}, F_{nt})$

Φ_f 1 AASHTO 6.5.4.2

$\Phi M_{n\text{ veh. \& -ped}} =$ 3339 *k-in*

$\Phi M_{n\text{ +ped}} =$ 3061 *k-in*

Unstiffened Web Shear Resistance AASHTO 6.10.9.2

$\Phi V_n = \Phi_v V_{cr} = \Phi_v C V_p$

Φ_v 1 AASHTO 6.5.4.2

$V_p = 0.58 * F_{yw} * D * t_w =$ 173.6 *k* AASHTO 6.10.9.2-2

D/t_w 47.5

k 5

$1.12 * \sqrt{(E*k/F_{yw})} =$ 60.3

if $D/t_w < 1.12 * \sqrt{(E*k/F_{yw})} \rightarrow C=1$

C 1

$\Phi V_n =$ 173.6 *k*

Rating Factors

$$RF_{general} = \frac{(C - \gamma_{DC}DC - \gamma_{DW}DW +/- \gamma_P P)}{\gamma_{LL} LL(1+IM)}$$

AASHTO MBE 6A.4.2.1-1
(Impact for vehicles only)

$C_{Str\text{-}I} = \Phi_c \Phi_s \Phi_n R_n$ AASHTO MBE 6A.4.2.1-2

$\Phi_c \Phi_s \geq 0.85$ AASHTO MBE 6A.4.2.1-3

Φ_s 0.85 AASHTO MBE 6A.4.2.4

γ_{DC} 1.25

$\gamma_{LL\text{ inv.}}$ 1.75

$\gamma_{LL\text{ op.}}$ 1.35

IM 0 AASHTO LRFD Ped. Bridge Manual 3.2

Flexure

Condition	Good	Fair	Poor
Φ_c	1	0.95	0.85
C [k-in]	2602	2602	2602
$RF_{pedestrian\ inventory}$	**3.30**	**3.30**	**3.30**
$RF_{pedestrian\ operating}$	**4.28**	**4.28**	**4.28**
C [k-in]	2838	2838	2838
$RF_{vehicle\ inventory}$	**1.45**	**1.45**	**1.45**
$RF_{vehicle\ operating}$	**1.88**	**1.88**	**1.88**

Shear

Condition	Good	Fair	Poor
Φ_c	1	0.95	0.85
C [k]	148	148	148
$RF_{pedestrian\ inventory}$	**38.5**	**38.5**	**38.5**
$RF_{pedestrian\ operating}$	**49.9**	**49.9**	**49.9**
$RF_{vehicle\ inventory}$	**11.0**	**11.0**	**11.0**
$RF_{vehicle\ operating}$	**14.3**	**14.3**	**14.3**

North Suspension Bridge Load Rating (LRFR Method)

Floorbeams

L	9.5	*ft*
Spacing	15.25	*ft*

Size W6x20

b_f	6.08	*in*	F_{yc}	50	*ksi*
t_f	0.37	*in*	F_{yw}	50	*ksi*
r_t	1.70	*in*	$F_{yr} = 0.7F_{yc}$	35	*ksi*
d	6.2	*in*	E	29000	*ksi*
D	5.47	*in*			
t_w	0.26	*in*			
S_x	13.4	in^3			

Dead Loads

Moment	M_{max}	14.83	*k-in*	(from CSiBridge Model)
Shear	V_{max}	0.86	*k*	

Live Loads Pedestrian and Vehicular loads act seperately

Pedestrian: PL 90 *psf* AASHTO LRFD Ped Bridge 3.1

Weight $P_{PL} = PL*A_{trib.}$ = 13.0 *k* (two point loads of this mag.)

Moment	M_{max}	5.19	*k-in*	(from CSiBridge Model)
Shear	V_{max}	0.01	*k*	

Vehicular:

	LL	Truck 1	Truck 2	
	Total	16.2	21.19	*k*
Weight	Axle 1 Wheels	6.08	7.95	*k*
	Axle 2 Wheels	2.03	2.65	*k*
	wheel spacing	6	6	*ft*
	axle spacing	6.58	8.25	*ft*

Moment	M_{max}	12.24	*k-in*	(From CSiBridge Model, Truck 2 controls)
Shear	V_{max}	0.09	*k*	

Capacity

Local Buckling Resistance AASHTO 6.10.8.2.2

$\lambda_f = b_{fc}/2t_{fc}$ =	8.33	AASHTO 6.10.8.2.2-3
$\lambda_{pf} = 0.38*\sqrt{(E/F_{yc})}$ =	9.15	AASHTO 6.10.8.2.2-4
$\lambda_{rf} = 0.56*\sqrt{(E/F_{yr})}$ =	13.49	AASHTO 6.10.8.2.2-5

$\lambda_f < \lambda_{pf} \rightarrow$ $F_{nc} = R_b*R_h*F_{yc}$ AASHTO 6.10.8.2.2-1

R_b	1	AASHTO 6.10.1.10.2
R_h	1	AASHTO 6.10.1.10.1 (constructability is not checked)
F_{nc} =	50 *ksi*	

Lateral Torsional Buckling AASHTO 6.10.8.2.3

L_b	9.5 *ft*	
$L_p = r_t*\sqrt{(E/F_{yc})}$ =	3.41 *ft*	AASHTO 6.10.8.2.3-4
$L_r = \pi*r_t*\sqrt{(E/F_{yr})}$ =	12.81 *ft*	AASHTO 6.10.8.2.3-5

$L_p < L_b < L_r \rightarrow F_{nc} = C_b[1-(1-F_{yr}/(R_hF_{yc}))((L_b-L_p)/(L_r-L_p))]R_bR_hF_{yc} < R_bR_hF_{yc}$

$C_b = 1.75 - 1.05(M_1/M_2) + 0.3(M_1/M_2)^2 \leq 2.3$ AASHTO 6.10.8.2.3-7

$M_{2\,(veh.)}$ =	12.2 *k-in*		largest moment at end of braced length
$M_{mid\,(veh.)}$=	10.7 *k-in*		moment at middle of braced length
$M_{0\,(veh.)}$ =	9.3 *k-in*		smallest moment at end of braced length
$M_{1\,(veh.)} = M_{0\,(veh.)}$ =		9.3 *k-in*	AASTHO A6.3.3-12
$C_{b\,(vehicle)}$ =	1.13		
$M_{2\,(ped.)}$ =	5.2 *k-in*		largest moment at end of braced length
$M_{mid\,(ped.)}$=	4.8 *k-in*		moment at middle of braced length
$M_{0\,(ped.)}$ =	4.5 *k-in*		smallest moment at end of braced length
$M_{1\,(ped.)} = M_{0\,(ped.)}$ =		4.5 *k-in*	AASTHO A6.3.3-12
$C_{b\,(ped.)}$ =	1.03		
$F_{nc\,(veh.)}$ =	45.4 *ksi*		
$F_{nc\,(ped.)}$ =	41.7 *ksi*		

Tension Flange Flexural Resistance

$F_{nt} = R_h*F_{yt}$ = 50 *ksi* AASHTO 6.10.8.3-1

Minimum Flexural Resistance

$\Phi M_n = \Phi_f*S_x*\min(F_{nc},F_{nt})$

Φ_f	1	AASHTO 6.5.4.2
ΦM_n =	558 *k-in*	

Unstiffened Web Shear Resistance AASHTO 6.10.9.2

$\Phi V_n = \Phi_v V_{cr} = \Phi_v C V_p$

Φ_v	1	AASHTO 6.5.4.2

$V_p = 0.58*F_{yw}*D*t_w =$ 41.2 *k* AASHTO 6.10.9.2-2

D/t_w	21.0
k	5
$1.12*\sqrt{E*k/F_{yw}} =$	60.3
if $D/t_w < 1.12*\sqrt{E*k/F_{yw}} \rightarrow C=1$	
C	1

$\Phi V_n =$ 41.2 *k*

Rating Factors

$$RF = \frac{(C - \gamma_{DC}DC - \gamma_{DW}DW +/- \gamma_P P)}{\gamma_{LL}LL(1+IM)}$$ AASHTO MBE 6A.4.2.1-1

$C_{Str-I} = \Phi_c\Phi_s\Phi_n R_n$ AASHTO MBE 6A.4.2.1-2

$\Phi_c\Phi_s \geq 0.85$ AASHTO MBE 6A.4.2.1-3

Φ_s 1 AASHTO MBE 6A.4.2.4

γ_{DC}	1.25	
$\gamma_{LL\ inv.}$	1.75	
$\gamma_{LL\ op.}$	1.35	
IM	0	AASHTO LRFD Ped. Bridge Manual 3.2

Flexure

Condition	Good	Fair	Poor
Φ_c	1	0.95	0.85
C [k-in]	558	530	475
$RF_{pedestrian\ inventory}$	**59.5**	**56.4**	**50.3**
$RF_{pedestrian\ operating}$	**77.1**	**73.1**	**65.1**
$RF_{vehicle\ inventory}$	**25.2**	**23.9**	**21.3**
$RF_{vehicle\ operating}$	**32.7**	**31.0**	**27.6**

Shear

Condition	Good	Fair	Poor
Φ_c	1	0.95	0.85
C [k]	41.2	39.2	35.1
$RF_{pedestrian\ inventory}$	**1000**	**1000**	**1000**
$RF_{pedestrian\ operating}$	**1000**	**1000**	**1000**
$RF_{vehicle\ inventory}$	**255**	**242**	**216**
$RF_{vehicle\ operating}$	**331**	**314**	**280**

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North Suspension Bridge Load Rating (LRFR Method)

Crossbracing

L		18 *ft*			
Size	W6x15				
	b_f	5.99 *in*	F_{yc}	50 *ksi*	
	t_f	0.26 *in*	F_{yw}	50 *ksi*	
	r_t	1.66 *in*	$F_{yr} = 0.7F_{yc}$	35 *ksi*	
	d	5.99 *in*	E	29000 *ksi*	
	D	5.47 *in*			
	t_w	0.23 *in*			
	S_x	29.1 in^3			

Dead Loads

Moment	M_{max}	11.85 *k-in*	(from CSiBridge Model)
Shear	V_{max}	0.24 *k*	

Live Loads Pedestrian and Vehicular loads act seperately

Pedestrian: PL 90 *psf* AASHTO LRFD Ped Bridge 3.1

Moment	M_{max}	14.6 *k-in*	(from CSiBridge Model)
Shear	V_{max}	0.09 *k*	

Vehicular:

	LL	Truck 1	Truck 2	
	Total	16.2	21.19	*k*
Weight	Axle 1 Wheels	6.08	7.95	*k*
	Axle 2 Wheels	2.03	2.65	*k*
	wheel spacing	6	6	*ft*
	axle spacing	6.58	8.25	*ft*

Moment	M_{max}	47.3 *k-in*	(From CSiBridge Model, Truck 2 controls)
Shear	V_{max}	0.25 *k*	

Capacity

Local Buckling Resistance		AASHTO 6.10.8.2.2
$\lambda_f = b_{fc}/2t_{fc}$ =	11.52	AASHTO 6.10.8.2.2-3
$\lambda_{pf} = 0.38*\sqrt{(E/F_{yc})}$ =	9.15	AASHTO 6.10.8.2.2-4
$\lambda_{rf} = 0.56*\sqrt{(E/F_{yr})}$ =	13.49	AASHTO 6.10.8.2.2-5

$\lambda_{pf} < \lambda_f < \lambda_{rf} \rightarrow F_{nc} = [1-(1-F_{yr}/R_hF_y)((\lambda_f-\lambda_{pf})/(\lambda_{rf}-\lambda_{pf}))]R_bR_hF_{yc}$ AASHTO 6.10.8.2.2-1

R_b 1 AASHTO 6.10.1.10.2

R_h 1 AASHTO 6.10.1.10.1 (constructability is not checked)

F_{nc} = 41.8 *ksi*

Lateral Torsional Buckling AASHTO 6.10.8.2.3

L_b 18 *ft*

$L_p = r_t*\sqrt{(E/F_{yc})}$ = 3.33 *ft* AASHTO 6.10.8.2.3-4

$L_r = \pi*r_t*\sqrt{(E/F_{yr})}$ = 12.51 *ft* AASHTO 6.10.8.2.3-5

$L_b > L_r \rightarrow F_{nc} = F_{cr} < R_bR_hF_{yc}$

$F_{cr} = C_bR_b\pi^2E/(L_b/r_t)^2$

C_b = 1

F_{cr} = 16.9 *ksi*

F_{nc} = 16.9 *ksi*

Tension Flange Flexural Resistance

$F_{nt} = R_h*F_{yt}$ = 50 *ksi* AASHTO 6.10.8.3-1

Minimum Flexural Resistance

$\Phi M_n = \Phi_f*S_x*\min(F_{nc},F_{nt})$

Φ_f 1 AASHTO 6.5.4.2

ΦM_n = 492 *k-in*

Unstiffened Web Shear Resistance AASHTO 6.10.9.2

$\Phi V_n = \Phi_v V_{cr} = \Phi_v C V_p$

Φ_v 1 AASHTO 6.5.4.2

$V_p = 0.58*F_{yw}*D*t_w$ = 36.5 *k* AASHTO 6.10.9.2-2

D/t_w 23.8

k 5

$1.12*\sqrt{(E*k/F_{yw})}$ = 60.3

if $D/t_w < 1.12*\sqrt{(E*k/F_{yw})} \rightarrow C=1$

C 1

ΦV_n = 36.5 *k*

Rating Factors

$$RF = \frac{(C - \gamma_{DC}DC - \gamma_{DW}DW +/- \gamma_P P)}{\gamma_{LL}LL(1+IM)}$$ AASHTO MBE 6A.4.2.1-1

$C_{Str-I} = \Phi_c\Phi_s\Phi_n R_n$ AASHTO MBE 6A.4.2.1-2

$\Phi_c\Phi_s \geq 0.85$ AASHTO MBE 6A.4.2.1-3

Φ_s 1 AASHTO MBE 6A.4.2.4

γ_{DC}	1.25	
$\gamma_{LL\ inv.}$	1.75	
$\gamma_{LL\ op.}$	1.35	
IM	0	AASHTO LRFD Ped. Bridge Manual 3.2

Flexure

Condition	Good	Fair	Poor
Φ_c	1	0.95	0.85
C [k-in]	492	467	418
$RF_{pedestrian\ inventory}$	**18.6**	**17.7**	**15.8**
$RF_{pedestrian\ operating}$	**24.2**	**22.9**	**20.4**
$RF_{vehicle\ inventory}$	**5.76**	**5.47**	**4.87**
$RF_{vehicle\ operating}$	**7.47**	**7.09**	**6.31**

Shear

Condition	Good	Fair	Poor
Φ_c	1	0.95	0.85
C [k]	36.5	34.7	31.0
$RF_{pedestrian\ inventory}$	**230**	**218**	**195**
$RF_{pedestrian\ operating}$	**298**	**283**	**253**
$RF_{vehicle\ inventory}$	**83.4**	**79.2**	**70.8**
$RF_{vehicle\ operating}$	**108**	**103**	**91.7**

North Suspension Bridge Load Rating (LRFR Method)

Hanger Cables

Size	$^{11}/_{16}$"			(Structural Steel Strand ASTM - A586, Class A Coating)
	A_g	0.284	*in^2*	
	Breaking Force	58	*k*	(from Bethlehem Wire Rope catalog)
	E	24000	*ksi*	

Dead Loads

Axial	P_{max}	8.85	*k*	(from CSiBridge Model)

Live Loads Pedestrian and Vehicular loads act seperately

Pedestrian:	PL	90	*psf*	AASHTO LRFD Ped Bridge 3.1
Axial	P_{max}	6.79	*k*	(from CSiBridge Model)

Vehicular:		LL	Truck 1	Truck 2	
		Total	16.2	21.19	*k*
	Weight	Axle 1 Wheels	6.08	7.95	*k*
		Axle 2 Wheels	2.03	2.65	*k*
		wheel spacing	6	6	*ft*
		axle spacing	6.58	8.25	*ft*

Axial	P_{max}	1.65	*k*	(From CSiBridge Model, Truck 2 controls)

Capacity

Tensile Reistance

$\Phi P_n = \Phi_u F_y A_n R_p U$ AASHTO 6.8.2.1-2

Φ_u	0.8	AASHTO 6.5.4.2
$F_y A_n$ = Breaking Force		
R_p	1.0	
U	1.0	

$\Phi P_n =$ 46.4 *k*

Rating Factors

$$RF = \frac{(C - \gamma_{DC}DC - \gamma_{DW}DW +/- \gamma_P P)}{\gamma_{LL}LL(1+IM)}$$ AASHTO MBE 6A.4.2.1-1

$C_{Str\text{-}I} = \Phi_c \Phi_s \Phi_n R_n$ AASHTO MBE 6A.4.2.1-2

$\Phi_c \Phi_s \geq 0.85$ AASHTO MBE 6A.4.2.1-3

Φ_s 0.85 AASHTO MBE 6A.4.2.4

γ_{DC}	1.25	
$\gamma_{LL\ inv.}$	1.75	
$\gamma_{LL\ op.}$	1.35	
IM	0	AASHTO LRFD Ped. Bridge Manual 3.2

Axial

Condition	Good	Fair	Poor
Φ_c	1	0.95	0.85
C [k]	39.4	39.4	39.4
$RF_{pedestrian\ inventory}$	**2.39**	**2.39**	**2.39**
$RF_{pedestrian\ operating}$	**3.10**	**3.10**	**3.10**
$RF_{vehicle\ inventory}$	**9.83**	**9.83**	**9.83**
$RF_{vehicle\ operating}$	**12.7**	**12.7**	**12.7**

North Suspension Bridge Load Rating (LRFR Method)

Main Cables

Size	2 $^{7}/_{8}$"			(Structural Steel Rope - ASTM A603, Class A Coating)
	A_g	3.91	*in^2*	
	Nominal Strength	758	*k*	(from Bethlehem Wire Rope catalog)
	E	20000	*ksi*	

Dead Loads

Axial	P_{max}	177.3	*k*	(from CSiBridge Model)

Live Loads Pedestrian and Vehicular loads act seperately

Pedestrian:		PL	90	*psf*	AASHTO LRFD Ped Bridge 3.1
	Axial	P_{max}	129.6	*k*	(from CSiBridge Model)

Vehicular:		LL	Truck 1	Truck 2	
		Total	16.2	21.19	*k*
	Weight	Axle 1 Wheels	6.08	7.95	*k*
		Axle 2 Wheels	2.03	2.65	*k*
		wheel spacing	6	6	*ft*
		axle spacing	6.58	8.25	*ft*

Axial	P_{max}	19.1	*k*	(From CSiBridge Model, Truck 2 controls)

Capacity

Tensile Reistance

$\Phi P_n = \Phi_u F_y A_n R_p U$ AASHTO 6.8.2.1-2

Φ_u	0.8	AASHTO 6.5.4.2
$F_y A_n$ = Breaking Force		
R_p	1.0	
U	1.0	

$\Phi P_n =$ 606 *k*

Rating Factors

$$RF = \frac{(C - \gamma_{DC}DC - \gamma_{DW}DW +/- \gamma_P P)}{\gamma_{LL}LL(1+IM)}$$ AASHTO MBE 6A.4.2.1-1

$C_{Str\text{-}I} = \Phi_c \Phi_s \Phi_n R_n$ AASHTO MBE 6A.4.2.1-2

$\Phi_c \Phi_s \geq 0.85$ AASHTO MBE 6A.4.2.1-3

Φ_s 0.85 AASHTO MBE 6A.4.2.4

γ_{DC}	1.25	
$\gamma_{LL\ inv.}$	1.75	
$\gamma_{LL\ op.}$	1.35	
IM	0	AASHTO LRFD Ped. Bridge Manual 3.2

Axial

Condition	Good	Fair	Poor
Φ_c	1	0.95	0.85
C [k]	515	515	515
$RF_{pedestrian\ inventory}$	**1.30**	**1.30**	**1.30**
$RF_{pedestrian\ operating}$	**1.68**	**1.68**	**1.68**
$RF_{vehicle\ inventory}$	**8.79**	**8.79**	**8.79**
$RF_{vehicle\ operating}$	**11.4**	**11.4**	**11.4**

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North Suspension Bridge Load Rating (LRFR Method)

Backstay Cables

Size d = 2 3/4" (Structural Steel Strand ASTM - A586, Class A Coating)

A_g	4.54	in^2	
Nominal Strength	904	*k*	(from Bethlehem Wire Rope catalog)
E	23000	*ksi*	

Size d = 2 5/8" (Structural Steel Strand ASTM - A586, Class A Coating)

A_g	4.13	in^2	
Nominal Strength	834	*k*	(from Bethlehem Wire Rope catalog)
E	23000	*ksi*	

Dead Loads

		2 3/4"	2 5/8"		
Axial	P_{max}	219.2	205.4	*k*	(from CSiBridge Model)

Live Loads Pedestrian and Vehicular loads act seperately

Pedestrian: PL 90 *psf* AASHTO LRFD Ped Bridge 3.1

		2 3/4"	2 5/8"		
Axial	P_{max}	155.5	145.8	*k*	(from CSiBridge Model)

Vehicular:

	LL	Truck 1	Truck 2	
	Total	16.2	21.19	*k*
Weight	Axle 1 Wheels	6.08	7.95	*k*
	Axle 2 Wheels	2.03	2.65	*k*
	wheel spacing	6	6	*ft*
	axle spacing	6.58	8.25	*ft*

		2 3/4"	2 5/8"		
Axial	P_{max}	22.7	21.4	*k*	(from CSiBridge Model, Truck 2)

Capacity

Tensile Reistance

$\Phi P_n = \Phi_u F_y A_n R_p U$ AASHTO 6.8.2.1-2

Φ_u 0.8 AASHTO 6.5.4.2

$F_y A_n$ = Breaking Force

R_p 1.0

U 1.0

	2 3/4"	2 5/8"	
ΦP_n =	723	667	*k*

Rating Factors

$$RF = \frac{(C - \gamma_{DC}DC - \gamma_{DW}DW +/- \gamma_P P)}{\gamma_{LL}LL(1+IM)}$$ AASHTO MBE 6A.4.2.1-1

$C_{Str\text{-}I} = \Phi_c\Phi_s\Phi_n R_n$ AASHTO MBE 6A.4.2.1-2

$\Phi_c\Phi_s \geq 0.85$ AASHTO MBE 6A.4.2.1-3

Φ_s 0.85 AASHTO MBE 6A.4.2.4

γ_{DC}	1.25	
$\gamma_{LL\ inv.}$	1.75	
$\gamma_{LL\ op.}$	1.35	
IM	0	AASHTO LRFD Ped. Bridge Manual 3.2

<u>**Axial**</u>

	$2\ ^3/_4$"			$2\ ^5/_8$"		
Condition	Good	Fair	Poor	Good	Fair	Poor
Φ_c	1	0.95	0.85	1	0.95	0.85
C [k]	615	615	615	567	567	567
$RF_{pedestrian\ inventory}$	**1.25**	**1.25**	**1.25**	**1.08**	**1.08**	**1.08**
$RF_{pedestrian\ operating}$	**1.62**	**1.62**	**1.62**	**1.40**	**1.40**	**1.40**
$RF_{vehicle\ inventory}$	**8.58**	**8.58**	**8.58**	**7.38**	**7.38**	**7.38**
$RF_{vehicle\ operating}$	**11.1**	**11.1**	**11.1**	**9.57**	**9.57**	**9.57**

North Suspension Bridge Load Rating (LRFR Method)

Spreader Bars

Size	$3^1/_2$" Std. Pipe		
	A_g	2.51	*in^2*
	L	9.5	*ft*
	$D_{outside}$	4	*in^2*
	d_{inside}	3.55	*in^2*
	t	0.226	*in*
	r_s	1.34	*in*
	F_y	50	*ksi*
	E	29000	*ksi*

Dead Loads

Axial	P_{max}	15.5	*k*	(from CSiBridge Model)

Live Loads Pedestrian and Vehicular loads act seperately

Pedestrian:		PL	90	*psf*	AASHTO LRFD Ped Bridge 3.1
	Axial	P_{max}	11.3	*k*	(from CSiBridge Model)

Vehicular:		LL	Truck 1	Truck 2	
		Total	16.2	21.19	*k*
	Weight	Axle 1 Wheels	6.08	7.95	*k*
		Axle 2 Wheels	2.03	2.65	*k*
		wheel spacing	6	6	*ft*
		axle spacing	6.58	8.25	*ft*

Axial	P_{max}	1.64	*k*	(from CSiBridge Model, Truck 2 controls)

Capacity

Compression Resistance			AASHTO 6.9.4.1.1
K	0.65		AASHTO 4.6.2.5
Φ_c	0.9		AASHTO 6.5.4.2
$P_e =$	$\frac{\pi^2 E*A_g}{(K*l/r_s)^2}$		AASHTO 6.9.4.1.2-1
$P_o = QF_yA_g$			AASHTO 6.9.4.1.1

D	4	*in*	
t	0.226	*in*	
D/t	17.7	→ Nonslender	
$0.11*E/F_y$	63.8		
Q	1.0		AASHTO 6.9.4.2

P_e	235 *k*	AASHTO 6.9.4.1.2-1
P_o	126 *k*	AASHTO 6.9.4.1.1
P_e/P_o =	1.87	

$P_e/P_o > 0.44 \rightarrow$

$P_n = (0.658\text{^}(P_o/P_e))P_e$ AASHTO 6.9.4.1.1-1

P_n = 100 *k*

ΦP_n = 90.3 *k*

Rating Factors

$$RF = \frac{(C - \gamma_{DC}DC - \gamma_{DW}DW +/- \gamma_P P)}{\gamma_{LL}LL(1+IM)}$$ AASHTO MBE 6A.4.2.1-1

$C_{Str\text{-}I} = \Phi_c\Phi_s\Phi_n R_n$		AASHTO MBE 6A.4.2.1-2
$\Phi_c\Phi_s \geq 0.85$		AASHTO MBE 6A.4.2.1-3
Φ_s	1	AASHTO MBE 6A.4.2.4

γ_{DC}	1.25	
$\gamma_{LL\ inv.}$	1.75	
$\gamma_{LL\ op.}$	1.35	
IM	0	AASHTO LRFD Ped. Bridge Manual 3.2

Axial

Condition	Good	Fair	Poor
Φ_c	1	0.95	0.85
C [k]	90.3	85.8	76.8
$RF_{pedestrian\ inventory}$	**3.59**	**3.36**	**2.91**
$RF_{pedestrian\ operating}$	**4.66**	**4.36**	**3.77**
$RF_{vehicle\ inventory}$	**24.8**	**23.2**	**20.0**
$RF_{vehicle\ operating}$	**32.1**	**30.0**	**26.0**

North Suspension Bridge Load Rating (LRFR Method)

Hanger Bolts

d	0.75	*in*	
d_{actual}	0.50	*in*	(Accounts for corrosion)
$d_{threads}$	0.65	*in*	(Based on equation AASTHO 6.13.2.10.2-1)
A_b	0.44	in^2	
$A_{b\ actual}$	0.20	in^2	
F_{ub}	120	*ksi*	(A325 Bolts)
E	29000	*ksi*	

Dead Loads Force in hanger bolts = hanger strand force divided by four (number of bolts/hanger)

Axial P_{max} 2.21 *k* (from CSiBridge Model)

Live Loads Pedestrian and Vehicular loads act seperately

Pedestrian: PL 90 *psf* AASHTO LRFD Ped Bridge 3.1

Axial P_{max} 1.70 *k* (from CSiBridge Model)

Vehicular:

	LL	Truck 1	Truck 2	
	Total	16.2	21.19	*k*
Weight	Axle 1 Wheels	6.08	7.95	*k*
	Axle 2 Wheels	2.03	2.65	*k*
	wheel spacing	6	6	*ft*
	axle spacing	6.58	8.25	*ft*

Axial P_{max} 0.41 *k* (from CSiBridge Model, Truck 2 controls)

Capacity

Tensile Reistance

If $d_{threads} < d_{actual}$:

$\Phi T_n = \Phi_t 0.76 A_b F_{ub}$ AASHTO 6.13.2.10.2-1

If $d_{threads} > d_{actual}$:

$\Phi T_n = \Phi_t A_{b\ actual} F_{ub}$ AASHTO 6.13.2.10.2-1

Φ_t 0.8

$\Phi T_n =$ 18.8 *k*

Rating Factors

$$RF = \frac{(C - \gamma_{DC}DC - \gamma_{DW}DW +/- \gamma_P P)}{\gamma_{LL}LL(1+IM)}$$ AASHTO MBE 6A.4.2.1-1

$C_{Str\text{-}I} = \Phi_c\Phi_s\Phi_n R_n$ AASHTO MBE 6A.4.2.1-2

$\Phi_c\Phi_s \geq 0.85$ AASHTO MBE 6A.4.2.1-3

Φ_s 1 AASHTO MBE 6A.4.2.4

γ_{DC}	1.25	
$\gamma_{LL\ inv.}$	1.75	
$\gamma_{LL\ op.}$	1.35	
IM	0	AASHTO LRFD Ped. Bridge Manual 3.2

Axial

Condition	Good	Fair	Poor
Φ_c	1	0.95	0.85
C [k]	18.8	17.9	16.0
$RF_{pedestrian\ inventory}$	**5.41**	**5.10**	**4.46**
$RF_{pedestrian\ operating}$	**7.02**	**6.61**	**5.78**
$RF_{vehicle\ inventory}$	**22.3**	**21.0**	**18.4**
$RF_{vehicle\ operating}$	**28.9**	**27.2**	**23.8**

North Suspension Bridge Load Rating (LRFR Method)

Concrete Pylons

d	30	*in*
A_g	707	*in^2*
A_{bars}	1.56	*in^2*
N_{bars}	22	*in*
$A_{spiral\ bars}$	0.11	*in^2*
$p_{spiral\ bars}$	1.75	*in*
f_y	60	*ksi*
clear cov.	1.5	
f'_c	5	*ksi*
γ_c	0.16	*kcf*
β_1	0.85	
L	52.25	*ft*

Dead Loads

Weight	W_{DL} =	41.0	*k*	
Moment	M_{DL} =	288	*k-in*	(From CSiBridge Model)
Axial	P_{DL} =	435	*k*	

Live Loads Pedestrian and Vehicular loads act seperately

Pedestrian:		PL	90	*psf*	AASHTO LRFD Ped Bridge 3.1
	Weight	W_{PL} =	115	*k/pylon*	
	Moment	M_{PL} =	3300	*k-in*	(From CSiBridge Model)
	Axial	P_{PL} =	284	*k*	

			Truck 1	Truck 2	
Vehicular:		LL	Truck 1	Truck 2	
		Total	16.2	21.19	*k*
	Weight	Axle 1 Wheels	6.08	7.95	*k*
		Axle 2 Wheels	2.03	2.65	*k*
		wheel spacing	6	6	*ft*
		axle spacing	6.58	8.25	*ft*

Moment	M_{LL} =	481	*k-in*	(From CSiBridge Model, Truck 2 controls)
Axial	P_{LL} =	42.2	*k*	

Capacity

Compression + Flexure AASHTO MBE Appendix G6A

$e_1 = M_{LL}/P_{LL}$

$e_{1\ ped.}$ = 11.6 *in*

$e_{1\ vehicle}$ = 11.4 *in*

$e_2 = M_{DL}/P_{DL}$

e_2 = 0.66 *in*

$\Phi M_{n\ ped.}$ = 14400 *k-in*

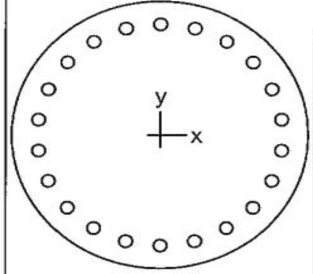
$\Phi M_{n\ veh.}$ = 14100 *k-in*

$\Phi P_{n\ ped.}$ = 1650 *k*

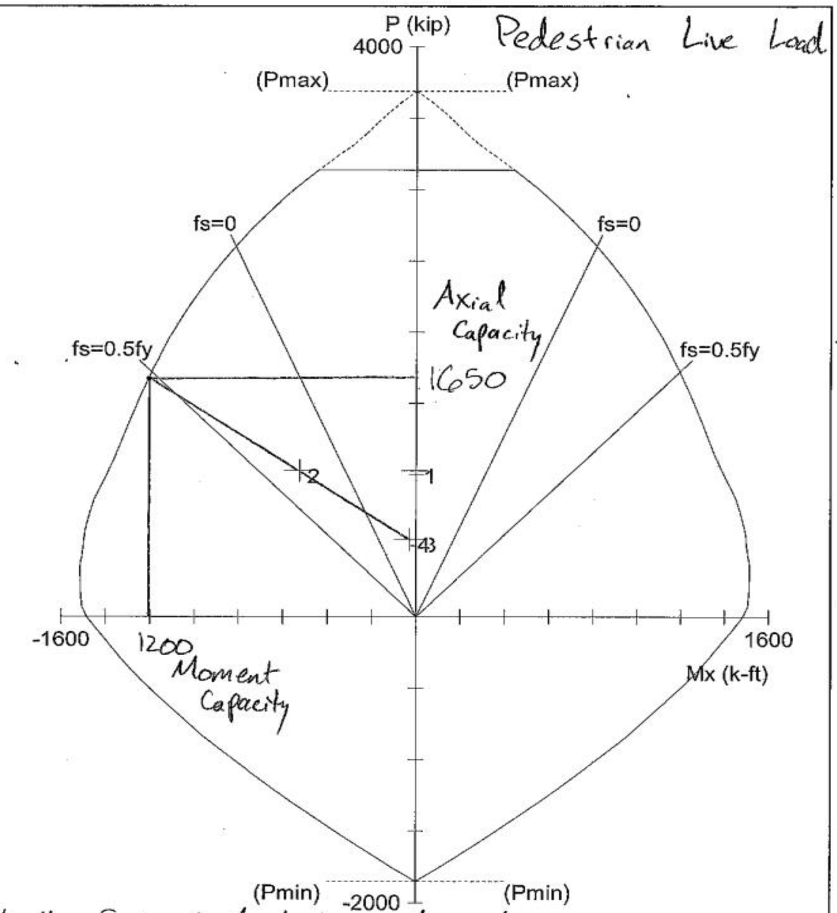
$\Phi P_{n\ veh.}$ = 1750 *k*

(From SpColumn)

**The capacity for concrete elements in compression and bending is determined from a P-M interaction diagram. The axial and bending capacities are assumed to be the values at the edge of the interaction diagram along the line that connects the factored dead and the factored live plus dead combined loading responses. Rating factors are calculated for both the max axial and bending conditions.*



30 in diam.



Code: ACI 318-08

Units: English

Run axis: About X-axis

Run option: Investigation

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 11/05/14

Time: 14:53:03

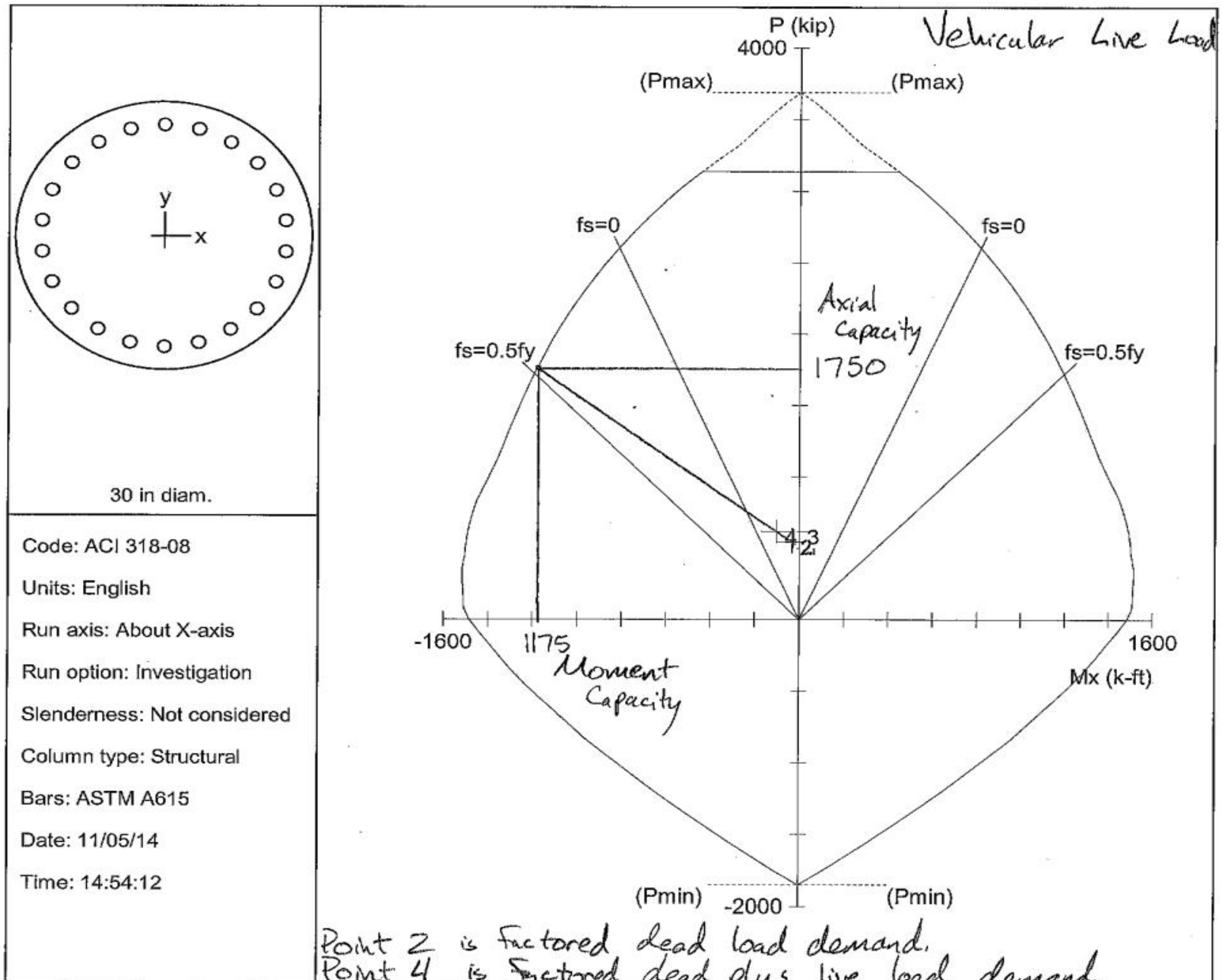
Point 4 is factored dead load demand.
Point 2 is factored dead plus live load demand.

spColumn v4.60. Licensed to: KPFF Consulting Engineers. License ID: 57305-1023324-4-1BE6D-26367

File: F:\Project Files\114176 (Spokane Riverfront Park Inspection and Analysis)\15 Load Ratin...\N Susp Pylons Ped.col

Project:

Column:		Engineer:	
f'c = 5 ksi	fy = 60 ksi	Ag = 706.858 in^2	22 #11 bars
Ec = 4031 ksi	Es = 29000 ksi	As = 34.32 in^2	rho = 4.86%
fc = 4.25 ksi		Xo = 0.00 in	Ix = 39760.8 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 39760.8 in^4
Beta1 = 0.8		Min clear spacing = 2.13 in	Clear cover = 1.88 in
Confinement: Spiral			
phi(a) = 0.85, phi(b) = 0.9, phi(c) = 0.75			



Code: ACI 318-08

Units: English

Run axis: About X-axis

Run option: Investigation

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 11/05/14

Time: 14:54:12

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File: F:\Project Files\114176 (Spokane Riverfront Park Inspection and Analysis)\15 Load Ratin...\N Susp Pylons Veh.col

Project:

Column:		Engineer:	
f'c = 5 ksi	fy = 60 ksi	Ag = 706.858 in^2	22 #11 bars
Ec = 4031 ksi	Es = 29000 ksi	As = 34.32 in^2	rho = 4.86%
fc = 4.25 ksi		Xo = 0.00 in	Ix = 39760.8 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 39760.8 in^4
Beta1 = 0.8		Min clear spacing = 2.13 in	Clear cover = 1.88 in
Confinement: Spiral			
phi(a) = 0.85, phi(b) = 0.9, phi(c) = 0.75			

Rating Factors

$$RF = \frac{(C - \gamma_{DC}DC - \gamma_{DW}DW +/- \gamma_{P}P)}{\gamma_{LL}LL(1+IM)}$$ AASHTO MBE 6A.4.2.1-1

$C_{Str\text{-}I} = \Phi_c\Phi_s\Phi_n R_n$ AASHTO MBE 6A.4.2.1-2

$\Phi_c\Phi_s \geq 0.85$ AASHTO MBE 6A.4.2.1-3

Φ_s 0.85 AASHTO MBE 6A.4.2.4

γ_{DC}	1.25	
$\gamma_{LL\ inv.}$	1.75	
$\gamma_{LL\ op.}$	1.35	
IM	0	AASHTO LRFD Ped. Bridge Manual 3.2

<u>Flexure</u>

Condition	Good	Fair	Poor
Φ_c	1	0.95	0.85
C [k-in]	12240	12240	12240
$RF_{pedestrian\ inventory}$	**2.06**	**2.06**	**2.06**
$RF_{pedestrian\ operating}$	**2.67**	**2.67**	**2.67**
C [k-in]	11985	11985	11985
$RF_{vehicle\ inventory}$	**13.8**	**13.8**	**13.8**
$RF_{vehicle\ operating}$	**17.9**	**17.9**	**17.9**

<u>Axial</u>

Condition	Good	Fair	Poor
Φ_c	1	0.95	0.85
C [k]	1403	1403	1403
$RF_{pedestrian\ inventory}$	**1.73**	**1.73**	**1.73**
$RF_{pedestrian\ operating}$	**2.24**	**2.24**	**2.24**
C [k]	1488	1488	1488
$RF_{vehicle\ inventory}$	**12.8**	**12.8**	**12.8**
$RF_{vehicle\ operating}$	**16.6**	**16.6**	**16.6**

North Suspension Bridge Load Rating (LRFR Method)

Summary

*Floorbeams are in fair condition (Φ_c =0.95) and Deck is in poor condition (Φ_c =0.85)

*All other members are in good condition (Φ_c =1)

Controlling Rating Factor & Failure Force	Pedestrian			Vehicle		
	Force	Inventory	Operating	Force	Inventory	Operating
Deck	**Flexure**	**0.51**	**0.66**	*N/A*	*N/A*	*N/A*
Girders	Flexure	3.30	4.28	Flexure	**1.45**	**1.88**
Floorbeams	Flexure	56.4	73.1	Flexure	23.9	31.0
Crossbracing	Flexure	18.6	24.2	Flexure	5.76	7.47
Hanger Cables	Axial	2.39	3.10	Axial	9.83	12.7
Main Cables	Axial	1.30	1.68	Axial	8.79	11.4
Backstay Cables	Axial	1.08	1.40	Axial	7.38	9.57
Spreader Bars	Axial	3.59	4.66	Axial	24.8	32.1
Hanger Bolts	Axial	4.46	5.78	Axial	18.4	23.8
Pylons	Axial	1.73	2.24	Axial	12.8	16.6

APPENDIX D

PHOTOGRAPH LOG
PHOTOGRAPH CONTACT SHEET

Bridge Name: North Suspension Bridge

Date of Inspection: 9/3/14-9/5/14

Camera No.	Photo No.	Location	Notes	By
A	262	H1 - H2 RT	Loose railing cover plate	MLF
A	263	H1 - H2 RT	Loose railing cover plate	MLF
A	318	H1 RT	Debris on bottom flanger of girder	JPG
A	320	H1 RT	Moderate corrosion on floorbeam	JPG
A	321	H1 RT	SIP deck form is corroded, exposed/missing concrete	JPG
A	322	H1 RT	Floorbeam has minor corrosion	JPG
A	324	H1 RT	Inside hanger bolt connection moderate corrosion	JPG
A	325	H1 RT	Girder, typical	JPG
A	326	H1 RT	Abutment/floorbeam	JPG
A	327	H1 RT	Abutment/floorbeam	JPG
A	328	H1 RT	Abutment/floorbeam	JPG
A	329	H2 RT	Girder good condition	JPG
A	330	H2 RT	Girder good condition	JPG
A	331	H2 RT	SIP deck form is corroded	JPG
A	332	H2 RT	Floorbeam is corroded	JPG
A	335	H2 RT	Minor corrosion inside hanger bolt connection	JPG
A	337	H3 RT	Heavily corroded floorbeam	JPG
A	338	H3 RT	Braces in good condition	JPG
A	339	H3 RT	Corroded formwork	JPG
A	340	H3 RT	Inside hanger bolt connection moderate corrosion	JPG
A	341	H4 RT	Girder splice in good condition	JPG
A	342	H4 RT	Girder splice in good condition	JPG
A	343	H4 RT	Floorbeam has minor corrosion	JPG
A				
A	345	H4 RT	Inside hanger bolt connection moderate corrosion	JPG
A	347	H4 RT	Corroded formwork	JPG
A	349	H5 RT	Debris on bottom flanger of girder	JPG
A	350	H5 RT	Debris on bottom flanger of girder	JPG
A	351	H5 RT	Floorbeam has heavy corrosion	JPG
A	352	H5 RT	Corroded formwork	JPG
A	353	H5 RT	Inside of girder	JPG
A	355	H5 RT	Heavy corrosioin inside hanger bolt connection	JPG
A	356	H6 RT	Floorbeam has heavy corrosion	JPG
A	357	H6 RT	Heavy corrosioin inside hanger bolt connection	JPG
A	358	H6 RT	Heavy corrosioin inside hanger bolt connection	JPG
A	359	H6 RT	Girder splice in good condition	JPG
A	361	H6 RT	Girder splice in good condition	JPG
A	362	H6 RT	Corroded formwork	JPG
A	368	H7 LT	No erection bolts in connectioin	JPG
A	369	H7 LT	Floorbeam is heavily corroded	JPG
A	370	H7 LT	Flaking in girder web	JPG
A	372	H7 LT	Corroded formwork	JPG
A	373	H7 LT	Inside hanger bolt connection moderate corrosion	JPG
A	374	H7 LT	Inside hanger bolt connection moderate corrosion	JPG
A	375	H9 LT	No erection bolt in connectioin	JPG

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Bridge Name: North Suspension Bridge

Date of Inspection: 9/3/14-9/5/14

Camera No.	Photo No.	Location	Notes	By
A	376	H9 LT	No erection bolt in connectioin	JPG
A	377	H9 LT	No erection bolt in connectioin	JPG
A	378	H9 LT	Inside web of girder	JPG
A	379	H9 LT	Floorbeam is heavily corroded	JPG
A	380	H9 LT	SIP deck is corroded, concrete deck is exposed	JPG
A	381	H9 LT	Inside hanger bolt connection moderate corrosion	JPG
A	382	H10 LT	Flaking steel at bottom of connection plate	MLF
A	383	H10 LT	Loose erection bolt at connection	MLF
A	384	H11 LT	Missing/loose erection bolts	MLF
A	385	H11 RT	Missing erection bolts	MLF
A	386	H12 LT	Flaking steel at bottom of connection plate	MLF
A	387	H12 LT	Corrosion at girder - lateral brace connection	MLF
A	389	H12 LT	Splice plate, bolts have minor corrosioin	MLF
A	390	H13 LT	SIP deck is corroded, concrete deck is exposed	JPG
A	392	H14 LT	Girder splice	JPG
A	393	H14 LT	Debris at lateral brace - girder connection	JPG
A	394	H14 LT	Debris at lateral brace - girder connection	JPG
A	395	H14 LT	Floorbeam minor corrosion	JPG
A	396	H15 LT	SIP deck is corroded, concrete deck is exposed	JPG
A	397	H16 LT	Heavily corroded floorbeam	JPG
A	398	H16 LT	Heavily corroded floorbeam	JPG
A	399	H16 LT	Girder splice	JPG
A	401	H16 LT	Inside hanger bolt connection moderate corrosion	JPG
A	402	H16 LT	SIP deck is corroded, concrete deck is exposed	JPG
A	403	H16 LT	Corrosion at girder - lateral brace connection	JPG
A	404	H17 LT	Inside hanger bolt connection moderate corrosion	JPG
A	405	H17 LT	Floorbeam minor corrosion	JPG
A	406	H17 LT	Corrosion at girder - lateral brace connection	JPG
A	407	H17 LT	SIP deck is corroded, concrete deck is exposed	JPG
A	408	H17 LT	Girder at abutment	JPG
A	409	Pier 2	Rock wall abutment	JPG
A	427	Pier 1	Right girder at bearing	MLF
A	428	Pier 1	Abutment	MLF
A	429	Pier 1	Heavy corrosion top flange of right girder	MLF
A	430	Pier 1	Heavy corrosion floorbeam	MLF
A	431	Pier 1	Bearing right girder	MLF
C	2297	H1 RT deck	Typical deck transverse crack at 1/2 or 1/3 point every panel	
C	2298	H1 RT deck	Typical spalling, cracking around hangers at curb	
C	2299	H3 RT deck	Spalling and exposed rebar at curb	
C	2300	H8 RT	Curb is spalling at hanger connection	JPG
C	2301	H8 RT	Spall in deck	JPG
C	2302	H8 RT	Spall in deck	JPG
C	2303	H11 RT	Spall in deck	JPG
C	2304	H14 RT	Spall in deck with exposed reinforcement	JPG

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Bridge Name: North Suspension Bridge

Date of Inspection: 9/3/14-9/5/14

Camera No.	Photo No.	Location	Notes	By
C	2305	H14 RT	Spall in deck with exposed reinforcement	JPG
C	2306	H16 RT	Deck spalling at joint	JPG
C	2307	Pier 2	Floorbeam / abutment anchors	JPG
C	2309	Pier 2	Floorbeam / abutment anchors	JPG
C	2310	Pier 2	Floorbeam / abutment anchors	JPG
C	2311	Pier 2	Girder/lateral bracing connection	JPG
C	2312	Pier 2	Girder bearing	JPG
C	2313	H7 LT	Plugged drain	JPG
C	2314	H7 LT	Exposed reinforcement in curb	JPG
C	2315	H7 LT	Plugged drain	JPG
C	2316	H7 LT	Drains are missing grate	JPG
C	2317	Pier 1	Expansion joint	JPG
C	2318	Pier 1	Expansion joint	JPG
C	2319	General	Deck, looking south	JPG
C	2320	General	Deck, looking south	JPG
C	2321	Pier 2	Expansion joint	JPG
6	1215	H1 LT	Outside view of girder	MLF
6	1216	H1 LT	Floorbeam	MLF
6	1218	H1 LT	Abutment/bracing	MLF
6	1219	H1 LT	Inside of girder corrosion at abutment	MLF
6	1220	H1 LT	Inside of girder corrosion at abutment	MLF
6	1221	H1 LT	Inside of girder corrosion at abutment	MLF
6	1222	H2 LT	Debris at lateral brace connection	MLF
6	1223	H2 LT	Corrosion in floorbeam	MLF
6	1224	H2 RT	Girder splice	MLF
6	1225	H2 LT	Girder splice	MLF
6	1226	H2 LT	Girder splice	MLF
6	1227	H1 LT	SIP deck corroded, deck spall	MLF
6	1228	H3 LT	Floorbeam corrosion	MLF
6	1229	H3 LT	Flaking bottom flange girder	MLF
6	1230	H3 LT	Flaking bottom flange girder	MLF
6	1231	H3 LT	SIP deck corrosion	MLF
6	1232	H4 LT	Girder splice	MLF
6	1233	H5 LT	Girder splice	MLF
6	1234	H5 LT	Floorbeam corrosion	MLF
6	1235	H5 LT	Floorbeam - girder corrosion	MLF
6	1236	H5 LT	Girder bottom flanger corrosion	MLF
6	1237	H5 LT	Inside hanger bolt connection moderate corrosion	MLF
6	1240	H6 LT	Outside hanger bolt connection	TW
6	1241	H6 LT	SIP deck corrosion	TW
6	1242	H6 LT	SIP deck corrosion	TW
6	1248	H6 LT	Lateral bracing connection	TW
6	1249	H6 LT	Girder splice	TW

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Project	Riverfront Park Bridges Inspection	By	M. Frymoyer	Sheet No.
Location	Spokane	Date	9/26/2014	4 OF10
Client	City of Spokane			Job No.
Inspection Photo Log				114176.12

Bridge Name: North Suspension Bridge

Date of Inspection: 9/3/14-9/5/14

Camera No.	Photo No.	Location	Notes	By
6	1250	H6 LT	Floorbeam minor corrosion	
6	1251	H6 LT	Bottom of girder	TW
6	1252	H6 LT	General view floor framing	TW
6	1253	H6 LT	General view floor framing	TW
6	1254	H6 LT	General view floor framing	TW
6	1255	H6 LT	General view of deck	TW
6	1256	H7 RT	Outside hanger bolt connection minor corrosion	BK
6	1257	H7 RT	Floorbeam - girder connection	BK
6	1258	H7 RT	Floorbeam - girder connection	BK
6	1259	H7 RT	Heavily corroded SIP deck form and floorbeam	BK
6	1260	H7 RT	Inside hanger bolt connection minor corrosion	BK
6	1261	H7 RT	Debris in connection	BK
6	1262	H8 RT	Outside hanger bolt connection minor corrosion	BK
6	1263	H8 RT	Girder splice	BK
6	1264	H8 RT	Outside hanger bolt connection minor corrosion	BK
6	1265	H8 RT	Floorbeam - girder connection	BK
6	1266	H8 RT	Inside hanger bolt connection minor corrosion	BK
6	1267	H8 LT	Floorbeam - girder connection	BK
6	1268	H8 LT	Floorbeam - girder - lateral brace connection	BK
6	1269	H9 RT	Outside hanger bolt connection minor corrosion	BK
6	1270	H9 RT	Outside hanger bolt connection minor corrosion	BK
6	1271	H9 RT	Outside hanger bolt connection minor corrosion	BK
6	1272	H9 RT	Outside hanger bolt connection minor corrosion	BK
6	1273	H9 RT	Heavily corroded connection floorbeam - lateral brace	BK
6	1274	H9 RT	Corroded floorbeam	BK
6	1275	H9 RT	Inside hanger bolt connection moderate corrosion	BK
6	1276	H9 RT	Inside hanger bolt connection moderate corrosion	BK
6	1277	H10 RT	Floorbeam - girder connection	BK
6	1278	H10 RT	Inside hanger bolt connection minor corrosion	BK
6	1279	H10 RT	Inside hanger bolt connection minor corrosion	BK
6	1280	H10 RT	Floorbeam - girder connection	BK
6	1281	H10 RT	SIP deck form corrosion	BK
6	1282	H11 RT	Outside hanger bolt connection minor corrosion	BK
6	1283	H11 RT	Floorbeam - lateral brace connection	BK
6	1284	H11 RT	Floorbeam - lateral brace connection	BK
6	1285	H11 RT	Inside hanger bolt connection minor corrosion	BK
6	1286	H11 RT	SIP deck form corrosion	BK
6	1287	H12 RT	Outside hanger bolt connection minor corrosion	BK
6	1288	H12 RT	Girder splice	BK
6	1289	H12 RT	Floorbeam - girder connection	BK
6	1290	H12 RT	SIP deck form corrosion	BK
6	1291	H13 RT	Outside hanger bolt connection minor corrosion	BK
6	1292	H13 RT	Floorbeam moderate corrosion	BK
6	1293	H13 RT	Inside hanger bolt connection minor corrosion	BK
6	1294	H13 RT	Lateral brace - girder connection	BK

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Bridge Name: North Suspension Bridge

Date of Inspection: 9/3/14-9/5/14

Camera No.	Photo No.	Location	Notes	By
6	1295	H13 RT	Lateral brace - girder connection	BK
6	1296	H13 RT	Debris in connection	BK
6	1297	H14 RT	Outside hanger bolt connection minor corrosion	BK
6	1298	H14 RT	Girder splice	BK
6	1299	H14 RT	Girder	BK
6	1300	H14 RT	Heavy corrosion floorbeam	BK
6	1301	H14 RT	Heavy corrosion floorbeam	BK
6	1302	H14 RT	Heavy corrosion floorbeam	BK
6	1303	H14 RT	SIP deck form corrosion	BK
6	1304	H15 RT	Girder web/top flange flaking	BK
6	1305	H15 RT	Floorbeam - lateral brace connection corroded	BK
6	1306	H15 RT	Floorbeam - lateral brace connection corroded	BK
6	1307	H15 RT	Debris in connection	BK
6	1308	H15 RT	Heavy corrosion floorbeam, hanger bolt connection	BK
7	5366	H16 RT	Outside hanger bolt connection	PG
7	5367	H16 RT	Girder	PG
7	5368	H16 RT	Girder	PG
7	5369	H16 RT	Girder	PG
7	5370	H16 RT	Girder splice	PG
7	5371	H16 RT	Inside hanger bolt connection	PG
7	5372	H16 RT	Inside hanger bolt connection	PG
7	5373	H16 RT	Inside view of girder	PG
7	5374	H16 RT	Inside view of girder	PG
7	5375	H16 RT	SIP deck form corrosion	PG
7	5376	H17 RT	Outside hanger bolt connection	PG
7	5377	H17 RT	Outside hanger bolt connection	PG
7	5378	H17 RT	Girder	PG
7	5379	H17 RT	Girder	PG
7	5380	H17 RT	Girder	PG
7	5381	H17 RT	Girder	PG
7	5382	H17 RT	Inside hanger bolt connection	PG
7	5383	H17 RT	Inside hanger bolt connection	PG
7	5384	H17 RT	SIP deck form corrosion	PG
7	5385	H17 RT	Floorbeam	PG
7	5386	H17 RT	Lateral bracing	PG
7	5387	H17 RT	Lateral bracing	PG
7	5423	Pier 1	Left girder bearing	PG
7	5424	Pier 1	Heavily corroded floorbeam	PG
7	5425	Pier 1	SIP deck form corrosion	PG
7	5427	Pier 1	Corrosion inside left girder	PG

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Project	Riverfront Park Bridges Inspection	By	M. Frymoyer	Sheet No.
Location	Spokane	Date	9/26/2014	6 OF10
Client	City of Spokane			Job No.
Inspection Photo Log				114176.12

Bridge Name: North Suspension Bridge

Date of Inspection: 9/3/14-9/5/14

Camera No.	Photo No.	Location	Notes	By
A	410	H15 RT	Top hanger to main cable connection	BK
A	411	H15 RT	Top hanger to main cable connection	BK
A	412	H15 RT	5% loss of galvanizing	BK
A	413	H15 RT	Top hanger to main cable connection	BK
A	414	H15 LT	Top hanger to main cable connection	BK
A	415	H15 LT	Top hanger to main cable connection	BK
A	416	H15 LT	Top hanger to main cable connection	BK
A	417	H15 LT	Top hanger to main cable connection	BK
A	418	H15 LT	Top hanger to main cable connection	BK
A	419	H16 LT	Top hanger to main cable connection	BK
A	420	H16 LT	Top hanger to main cable connection	BK
A	421	H16 LT	Top hanger to main cable connection	BK
A	422	H16 LT	Top hanger to main cable connection	BK
A	423	H16 RT	Top hanger to main cable connection	BK
A	424	H16 RT	Top hanger to main cable connection	BK
A	425	H16 RT	Top hanger to main cable connection	BK
A	426	H16 RT	Top hanger to main cable connection	BK
C	2343	H17 RT	Top hanger to main cable connection	PG
C	2344	H17 RT	Top hanger to main cable connection	PG
C	2345	H17 RT	Top hanger to main cable connection	PG
C	2346	H17 RT	Top hanger to main cable connection	PG
C	2348	SB4 RT north	General connection detail	PG
C	2349	SB4 RT north	General connection detail	PG
C	2350	SB4 RT north	General connection detail	PG
C	2351	SB 3 RT north	General connection detail	PG
C	2352	SB 3 RT north	General connection detail	PG
C	2353	SB3 LT north	General connectiond detail	PG
C	2354	H17 LT	Top hanger to main cable connection	PG
C	2355	H17 LT	Top hanger to main cable connection	PG
C	2356	H17 LT	Top hanger to main cable connection	PG
C	2357	H17 LT	Top hanger to main cable connection	PG
C	2358	SB4 LT north	General connection detail	PG
C	2359	SB4 LT north	General connection detail	PG
C	2360	SB4 LT north	General connection detail	PG
C	2361	SB3 LT north	General connection detail	PG
C	2362	SB3 LT north	General connection detail	PG
C	2363	SB3 LT north	General connection detail	PG
C	2364	SB 3 RT north	General connection detail	PG
C	2365		General view	PG
C	2366	SB2 LT north	General connection detail	PG
C	2367	SB2 LT north	General connection detail	PG
C	2368	SB2 LT north	General view	PG
C	2369	SB2 LT north	General connection detail	PG

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Bridge Name: North Suspension Bridge

Date of Inspection: 9/3/14-9/5/14

Camera No.	Photo No.	Location	Notes	By
C	2370	SB2 LT north	General connection detail	
C	2371	General		
C	2372	SB2 RT north		
C	2373	SB2 RT north	General connection detail	
C	2374	SB2 RT north	General connection detail	
C	2375	SB2 RT north	General connection detail	
C	2376	SB1 LT north	General connection detail	
C	2377	SB1 LT north	General connection detail	
C	2378	SB1 LT north	General connection detail	
C	2379	SB1 LT north	General connection detail	
C	2380	SB1 RT north	General connection detail	
C	2381	SB1 RT north	General connection detail	
C	2382	SB1 RT north	General connection detail	
C	2383	North HUB	Main suspension cable connection	
C	2384	North HUB	South side of tower connection	
C	2385	North HUB	South side of tower connection	
C	2386	North HUB	South side of tower connection	
C	2387	North HUB	South side of tower connection	
C	2388	North HUB	North side of tower connection	
C	2389	North HUB	North side of tower connection	
C	2390	North HUB	North side of tower connection	
C	2391	North HUB	North side of tower connection	
C	2392	North HUB	North side of tower connection	
C	2444	H14 RT	Top hanger to main cable connection	PG
C	2445	H14 RT	Top hanger to main cable connection	PG
C	2446	H14 RT	Top hanger to main cable connection	PG
C	2447	H14 RT	Top hanger to main cable connection	PG
C	2448	H14 LT	Top hanger to main cable connection	PG
C	2449	H14 LT	Top hanger to main cable connection	PG
C	2450	H14 LT	Top hanger to main cable connection	PG
C	2451	H13 LT	Top hanger to main cable connection	
C	2452	H13 LT	Top hanger to main cable connection	
C	2453	H13 LT	Top hanger to main cable connection	
C	2454	H13 RT	Top hanger to main cable connection	PG
C	2455	H13 RT	Top hanger to main cable connection	PG
C	2456	H13 RT	Top hanger to main cable connection	PG
C	2457	H13 RT	Top hanger to main cable connection	PG
6	1309	H6 RT	Top hanger to main cable connection	PG
6	1310	H6 RT	Top hanger to main cable connection	PG
6	1311	H6 RT	Top hanger to main cable connection	PG
6	1312	H6 RT	Top hanger to main cable connection	PG
6	1313	H7 RT	Top hanger to main cable connection	PG
6	1314	H7 RT	Top hanger to main cable connection	PG

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Project	Riverfront Park Bridges Inspection	By	M. Frymoyer	Sheet No.
Location	Spokane	Date	9/26/2014	8 OF10
Client	City of Spokane			Job No.
Inspection Photo Log				114176.12

Bridge Name: North Suspension Bridge

Date of Inspection: 9/3/14-9/5/14

Camera No.	Photo No.	Location	Notes	By
6	1315	H7 RT	Top hanger to main cable connection	PG
6	1316	H8 RT	Top hanger to main cable connection	PG
6	1317	H8 RT	Top hanger to main cable connection	PG
6	1318	H8 RT	Top hanger to main cable connection	PG
6	1319	H8 RT	Top hanger to main cable connection	PG
6	1320	H9 RT	Top hanger to main cable connection	PG
6	1321	H9 RT	Top hanger to main cable connection	PG
6	1322	H9 RT	Top hanger to main cable connection	PG
6	1323	H9 RT	Top hanger to main cable connection	PG
6	1324	H10 RT	Top hanger to main cable connection	PG
6	1325	H10 RT	Top hanger to main cable connection	PG
6	1326	H10 RT	Top hanger to main cable connection	PG
6	1327	H11 RT	Top hanger to main cable connection	PG
6	1328	H11 RT	Top hanger to main cable connection	PG
6	1329	H11 RT	Top hanger to main cable connection	PG
6	1330	H12 RT	Top hanger to main cable connection	PG
6	1331	H12 RT	Top hanger to main cable connection	PG
6	1332	H12 RT	Top hanger to main cable connection	PG
6	1333	H12 RT	Top hanger to main cable connection	PG
7	5333	H1 RT	Top hanger to main cable connection	PG
7	5334	H1 RT	Top hanger to main cable connection	PG
7	5335	H1 RT	Top hanger to main cable connection	PG
7	5336	H1 RT	Top hanger to main cable connection	PG
7	5337	H1 RT	Top hanger to main cable connection	PG
7	5338	SB3 RT south	General view of spreader bars	PG
7	5339	H1 LT	Top hanger to main cable connection	PG
7	5340	H1 LT	Top hanger to main cable connection	PG
7	5341	H1 LT	Top hanger to main cable connection	PG
7	5342	H1 LT	Top hanger to main cable connection	PG
7	5343	H1 LT	Top hanger to main cable connection	PG
7	5344	H1 LT	Top hanger to main cable connection	PG
7	5345	SB3 LT south	General connection detail	PG
7	5346	SB3 RT south	General connection detail	PG
7	5351	SB2 RT south	General connection detail	PG
7	5352	SB2 RT south	General connection detail	PG
7	5353	SB2 LT south	General connection detail	PG
7	5354	SB2 LT south	General connection detail	PG
7	5355	SB1 RT south	General connection detail	PG
7	5356	SB1 RT south	General connection detail	PG
7	5357	SB1 RT south	General connection detail	PG
7	5358	SB1 RT south	General connection detail	PG
7	5359	SB1 LT south	General connection detail	PG
7	5360	SB1 LT south	General connection detail	PG

Bridge Name: North Suspension Bridge

Date of Inspection: 9/3/14-9/5/14

Camera No.	Photo No.	Location	Notes	By
7	5362	SB1 LT south	General connection detail	PG
7	5363	South HUB	Main suspension cable connection	PG
7	5364	South HUB	Main suspension cable connection	PG
7	5365	South HUB	Main suspension cable connection	PG
7	5388	General	Ladder access for interior hanger connection inspection	MLF
7	5389	General	Ladder access for interior hanger connection inspection	MLF
7	5390	General	Ladder access for interior hanger connection inspection	MLF
7	5391	H5 LT	Top hanger to main cable connection	PG
7	5392	H5 LT	Top hanger to main cable connection	PG
7	5393	H5 LT	Top hanger to main cable connection	PG
7	5394	H5 RT	Top hanger to main cable connection	PG
7	5395	H5 RT	Top hanger to main cable connection	PG
7	5396	H5 RT	Top hanger to main cable connection	PG
7	5397	H4 LT	Top hanger to main cable connection	PG
7	5398	H4 LT	Top hanger to main cable connection	PG
7	5399	H4 LT	Top hanger to main cable connection	PG
7	5400	H4 LT	Top hanger to main cable connection	PG
7	5401	H4 LT	Top hanger to main cable connection	PG
7	5402	H4 RT	Top hanger to main cable connection	PG
7	5403	H4 RT	Top hanger to main cable connection	PG
7	5404	H4 RT	Top hanger to main cable connection	PG
7	5405	H4 RT	Top hanger to main cable connection	PG
7	5406	H3 LT	Top hanger to main cable connection	PG
7	5407	H3 LT	Top hanger to main cable connection	PG
7	5408	H3 LT	Top hanger to main cable connection	PG
7	5409	H3 LT	Top hanger to main cable connection	PG
7	5410	H3 RT	Top hanger to main cable connection	PG
7	5411	H3 RT	Top hanger to main cable connection	PG
7	5412	H3 RT	Top hanger to main cable connection	PG
7	5413	H3 RT	Top hanger to main cable connection	PG
7	5414	H2 RT	Top hanger to main cable connection	PG
7	5415	H2 RT	Top hanger to main cable connection	PG
7	5416	H2 RT	Top hanger to main cable connection	PG
7	5417	H2 RT	Top hanger to main cable connection	PG
7	5418	H2 RT	Top hanger to main cable connection	PG
7	5419	H2 LT	Top hanger to main cable connection	PG
7	5420	H2 LT	Top hanger to main cable connection	PG
7	5421	H2 LT	Top hanger to main cable connection	PG
7	5422	H2 LT	Top hanger to main cable connection	PG
7	5509	H6 LT	Top hanger to main cable connection	PG
7	5510	H6 LT	Top hanger to main cable connection	PG
7	5511	H6 LT	Top hanger to main cable connection	PG
7	5512	H7 LT	Top hanger to main cable connection	PG
7	5513	H7 LT	Top hanger to main cable connection	PG
7	5514	H7 LT	Top hanger to main cable connection	PG

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Bridge Name: North Suspension Bridge

Date of Inspection: 9/3/14-9/5/14

Camera No.	Photo No.	Location	Notes	By
7	5515	H8 LT	Top hanger to main cable connection	PG
7	5516	H8 LT	Top hanger to main cable connection	PG
7	5517	H8 LT	Top hanger to main cable connection	PG
7	5518	H9 LT	Top hanger to main cable connection	JPG
7	5519	H9 LT	Top hanger to main cable connection	JPG
7	5520	H9 LT	Top hanger to main cable connection	JPG
7	5521	H10 LT	Top hanger to main cable connection	JPG
7	5522	H10 LT	Top hanger to main cable connection	JPG
7	5523	H10 LT	Top hanger to main cable connection	JPG
7	5524	H10 LT	Cotter pins needs to be replaced	JPG
7	5525	H11 LT	Top hanger to main cable connection	JPG
7	5526	H11 LT	Top hanger to main cable connection	JPG
7	5527	H11 LT	Top hanger to main cable connection	JPG
7	5528	H12 LT	Top hanger to main cable connection	JPG
7	5529	H12 LT	Top hanger to main cable connection	JPG
7	5530	H12 LT	Top hanger to main cable connection	JPG
2	44	NW Anchor	Top view of anchorage	TW
2	45	NW Anchor	Cable / nuts	TW
2	46	NW Anchor	Cable / nuts	TW
2	47	NW Anchor	Cable / nuts	TW
2	48	NW Anchor	Cable anchorage	TW
2	50	NW Anchor	Tree growth around cable	TW
2	51	NW Anchor	Tree growth around cable	TW
2	52	NW Anchor	Cable	TW
2	53	General	Climbing access for under deck inspection	TW
2	54	General	Climbing access for under deck inspection	TW
2	55	NE Anchor	Anchorage block	TW
2	56	NE Anchor	Anchorage block	TW
2	57	NE Anchor	Anchorage nuts	TW
2	58	NE Anchor	1/4" movement at cable anchorage	TW
2	59	NE Anchor	Threaded rods in contact with soil	TW
2	60	NE Anchor	Cable anchorage	TW
2	61	NE Anchor	Cable	TW
2	62	NE Anchor	Cable	TW
2	63	NE Anchor	Anchorage block	TW
2	64	SE Anchor	Shrubs growing around anchorage block	TW
2	65	SE Anchor	Shrubs growing around anchorage block	TW
2	66	SE Anchor	Cable	TW
2	71	SW Anchor	Shrubs growing around anchorage block	TW
2	72	SW Anchor	Upper lock nut is not fully engaged	TW
2	73	SW Anchor	Upper lock nut is not fully engaged	TW
2	75	SW Anchor	Cable	TW
2	76	SW Anchor	Cable	TW
2	77	SW Anchor	Anchorage block	TW

North Suspension Bridge - Camera A Photos


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IMG_0262.JPG


IMG_0263.JPG


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North Suspension Bridge - Camera A Photos


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North Suspension Bridge - Camera A Photos


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North Suspension Bridge - Camera C Photos


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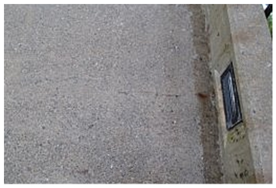
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North Suspension Bridge - Camera 6 Photos


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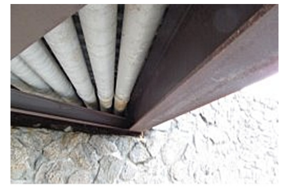
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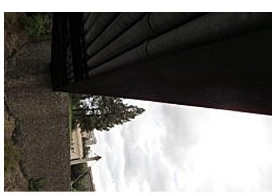
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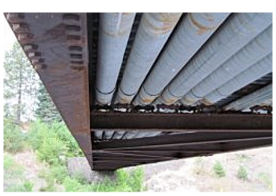
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North Suspension Bridge - Camera 6 Photos


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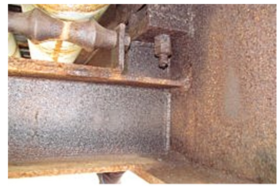
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North Suspension Bridge - Camera 6 Photos


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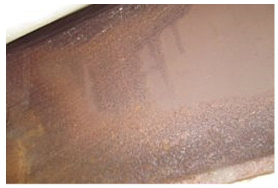
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North Suspension Bridge - Camera 7 Photos


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North Suspension Bridge - Camera A Photos Cables


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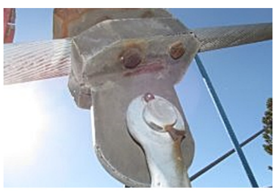
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North Suspension Bridge - Camera C Photos Cables


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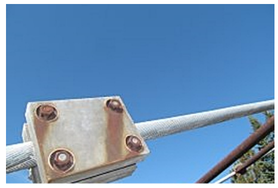
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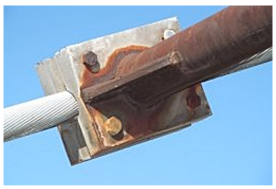
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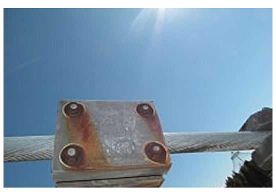
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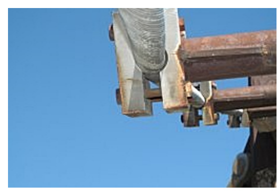
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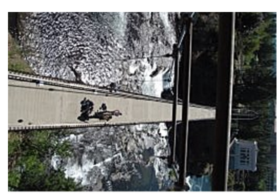
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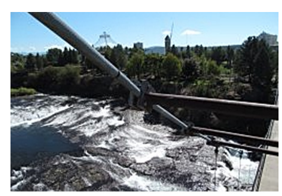
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North Suspension Bridge - Camera C Photos Cables


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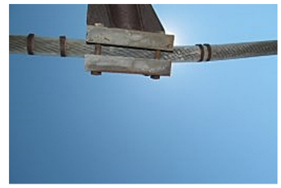
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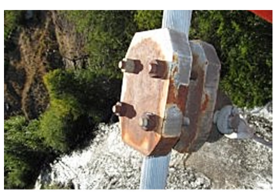
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North Suspension Bridge - Camera 6 Photos Cables


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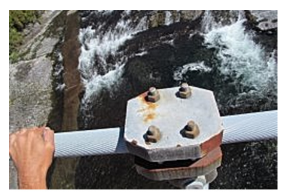
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North Suspension Bridge - Camera 7 Photos Cables


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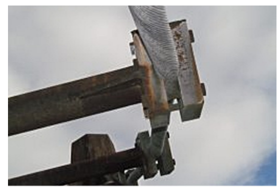
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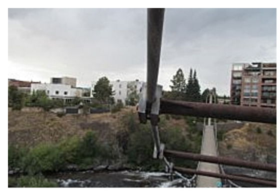
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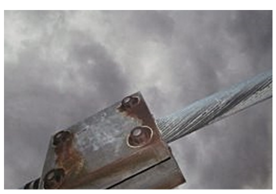
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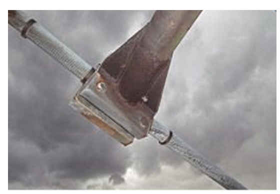
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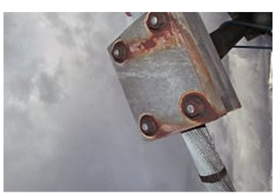
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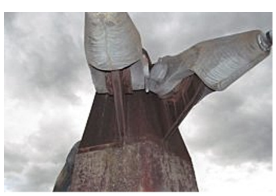
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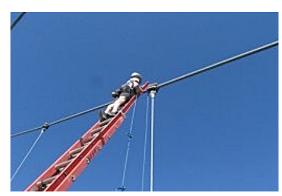
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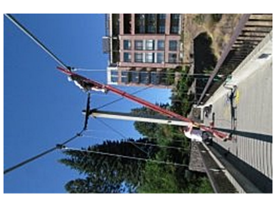
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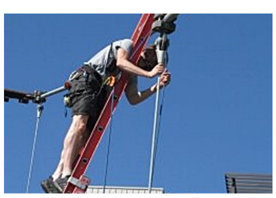
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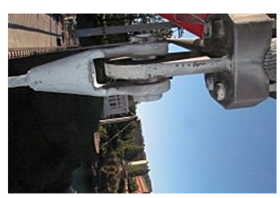
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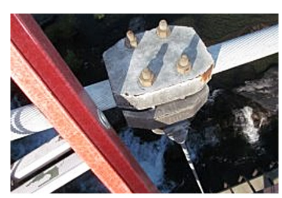
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North Suspension Bridge - Camera 7 Photos Cables


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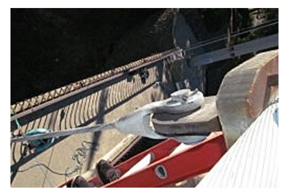
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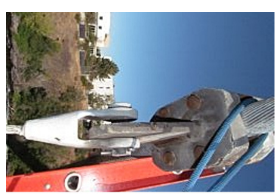
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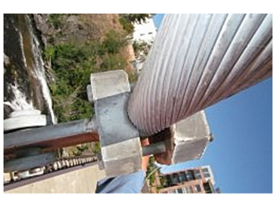
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North Suspension Bridge - Camera 7 Photos Cables


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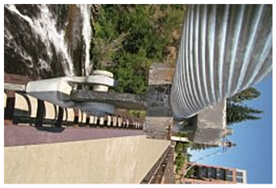
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North Suspension Bridge - Camera 2 Photos


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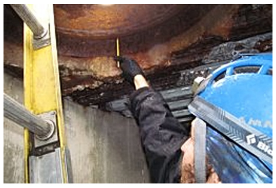
Project	Riverfront Park Bridges Inspection	By	M. Frymoyer	Sheet No.
Location	Spokane	Date	9/26/2014	1 OF1
Client	City of Spokane			Job No.
Inspection Photo Log				114176.12

Bridge Name: South Suspension Bridge Vaults

Date of Inspection: 9/2/14-9/5/14

Photo No.	Location	Notes	By
278	Vault 3	Vault access via extension ladder through manhole	MLF
279	Vault 3	Corroded stay in place formwork near manhole	MLF
280	Vault 3	Corroded stay in place formwork near manhole	MLF
281	Vault 3	Corroded stay in place formwork and support angle at column/tower	MLF
282	Vault 3	Corroded stay in place formwork near bridge abutment	MLF
283	Vault 3	Corroded/missing stay in place formwork near bridge abutment	MLF
284	Vault 3	Corroded/missing stay in place formwork near bridge abutment	MLF
285	Vault 3	Corroded/missing stay in place formwork near bridge abutment	MLF
286	Vault 3	Corroded/missing stay in place formwork near bridge abutment	MLF
288	Vault 4	Corroded/missing stay in place formwork near bridge abutment	MLF
289	Vault 4	Corroded/missing stay in place formwork near bridge abutment	MLF
290	Vault 4	Corroded stay in place formwork and support angle at column/tower	MLF
291	Vault 4	Corroded stay in place formwork near manhole	MLF
292	Vault 4	Corroded stay in place formwork and support angle at column/tower	MLF
293	Vault 4	Stay in place formwork connection	MLF
294	Vault 4	Corroded stay in place formwork near manhole	MLF
295	Vault 4	Corroded stay in place formwork near manhole	MLF

North Suspension Bridge Vaults - Photos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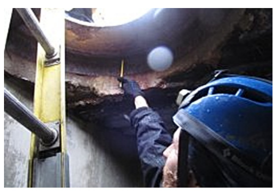
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