Bridge Factors Factual Report Attachment 71 – FIU Superstructure – Miscellaneous Details RFC Design Calculations

Miami, FL

HWY18MH009

(399 pages)

SUPERSTRUCTURE - MISCELLANEOUS DETAILS
RFC DESIGN CALCULATIONS

UniversityCity Prosperity Project
Pedestrian Bridge

FIGG Project No: 2262.03
FPID No: 434688.1.58.01

April 2017

CALCULATION COVER SHEET

Calculation Title: Superstructure – Miscellaneous Details

Calculation Number: 1

Total Number of Pages (including cover sheet): 397

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Prepared by: ENH/EDL Date: 4/11/17

Checked by: MF Date: 4/11/17

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NO. 34332
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PROFESSIONAL ENGINEER

Description and Purpose:

RFC design calculations for the superstructure miscellaneous details.

Design Basis/References/Assumptions

AASHTO LRFD Bridge Design Specifications, 7th Edition (2014) with 2015 Interims
FDOT Structures Design Guidelines, January 2015
AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges, 2nd Edition (2009)
Florida Building Code, 5th Edition (2014)
RFC Foundation Plans General Notes 1 (Sheet B-2)

Remarks/Conclusions/Results:

The superstructure miscellaneous details were found to be adequate according to the project design criteria.

Calculation Approved by: [redacted] 8/21/17

Design Task Manager Date

Revision No.:	Description of Revision:	Approved by: Design Manager	Date:

Written by: ADH	Revised by:	Approved by:
Date: 04.21.16	Date:	Date:

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Section I

Deck End Diaphragms

Design Summary

Project: FIU Pedestrian Bridge

Project No. : 2262.03

Design Task: Deck End Diaphragm Design Summary

Designer: Erika N. Hango, P.E.

Design Summary:

This binder contains the calculations performed for the RFC design of the deck end diaphragms. The calculations were prepared in accordance with the project design criteria, AASHTO LRFD Bridge Design Specifications 7th Edition with 2015 Interim Revisions, FDOT Structures Design Guidelines (January 2015), and AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges 2nd Edition (2009). The intent of this design was to determine the required concrete dimensions and the reinforcement requirements for each diaphragm.

The bridge was modeled using LARSA 4D (V7.08.05). Bearing reactions were extracted from the model for the design of the Type I and Type IV diaphragms. Load combinations were calculated with Sum It (V3.0.0) to determine the governing factored loads for design. The Strength I, III, and V and Service I and III limit states were investigated.

A strut and tie model was developed for the Type I and Type IV diaphragms to determine the steel area required for the tension tie at the bottom of the section between the two bearings. The tension tie, compressive strut, and node regions were designed per AASHTO LRFD 5.6.3.4, 5.6.3.3, and 5.6.3.5 respectively. Crack control reinforcement and shrinkage and temperature reinforcement were provided in accordance with AASHTO LRFD 5.6.3.6 and 5.10.8 respectively. The bearing replacement case was also checked, but found not to govern the design. Shear friction at the interface of the diaphragm and typical deck section was checked per AASHTO LRFD 5.8.4.1. A similar analysis was performed for the Type II diaphragm during casting (assuming section is supported by bearings) using construction loads. Reinforcement is provided at the top of the pylon base at the CIP Type III diaphragm.

Tendon pullout reinforcement was provided for all tendons with vertical deviations near the anchorages. A limiting reinforcing steel stress of 30 ksi for direct tension was used for tendon pullout per FIGG Design Directive No. 26. A plate model with a 3"x3" discretization was created using RISA-3D (V14.0.0) for each tendon size at each diaphragm. Tension forces from these models were used to calculate the required tie back reinforcement at the anchor face of the diaphragm and the required bursting reinforcement at the exit face of the diaphragm. For the tie back reinforcement, a limiting reinforcing steel stress of 36 ksi was used per AASHTO LRFD 5.10.9.3.4b. For the bursting reinforcement, a limiting reinforcing steel stress of 30 ksi was used per FIGG Design Directive No. 26.

A transverse analysis was performed to check the stresses at the root of the 5'-9" cantilevered wing. The two transverse tendons at the Type IV diaphragm were modeled using LARSA 4D to determine the effective post-tensioning force just after stressing, at end of construction, and at day 10,000. Mild reinforcement was provided at the bottom of the section for small tensile stresses (<< 30 ksi) and at the top of the section for shrinkage and temperature per AASHTO LRFD 5.10.8. Stresses at the root of the cantilevered wing were checked in a similar manner for the Type I, II, and III diaphragms. However, since there are no transverse tendons located within the diaphragm extents, an additional check for negative flexure was performed conservatively neglecting the effects of post-tensioning. Mild reinforcement was provided at the top of the section per AASHTO LRFD 5.7.3.2 & 5.7.3.3.2.

The diaphragm reinforcement requirements are summarized in Summary Table 1 below.

Summary Table 1				
Diaphragm	Tension Tie	Tendon Pullout (Per Tendon)	Tie Back (Per Half Diaphragm)	Bursting (Per Half Diaphragm)
Type I	16-#11	12k6: 3-#5 19k6: 5-#5	21-#9	31-#9
Type II	8-#11	12k6: 2-#5 19k6 (D2): 3-#5	13-#9, 10-#8, 1-#5	13-#9, 11-#8
Type III	N/A	N/A	8-#9, 6-#8	7-#9, 6-#8
Type IV	14-#11	6-#6	10-#9	18-#9

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	Designed: EDL	Project No.: 2262.03	Sheet of	
Tallahassee Denver Philadelphia Dallas	Checked: MF	Date: 03-Oct-16		

LOADS @ BEARINGS
PIER 1 (SOUTH END)

	Bearing	FX (kips)	FY (kips)	FZ (kips)
DC_EOC	Left	-10	1	-456
	Right	-10	1	-456
CR_EOC	Left	6	0	11
	Right	6	0	11
SH_EOC	Left	2	0	-4
	Right	2	0	-4
PT_EOC	Left	12	0	43
	Right	12	0	43
DC_D10K	Left	-10	1	-456
	Right	-10	1	-456
CR_D10K	Left	9	0	14
	Right	9	0	14
SH_D10K	Left	9	0	-55
	Right	9	0	-55
PT_D10K	Left	11	0	46
	Right	11	0	46
DW	Left	0	0	-21
	Right	0	0	-21
LL DECK_FULL	Left	-1	0	-76
	Right	-1	0	-76
LL DECK_MAIN	Left	-2	0	-86
	Right	-2	0	-86
LL DECK_BACK	Left	0	0	10
	Right	0	0	10
LL ROOF_FULL	Left	0	0	-9
	Right	0	0	-9
LL ROOF_MAIN	Left	0	0	-10
	Right	0	0	-10
LL ROOF_BACK	Left	0	0	1
	Right	0	0	1
LL OFFSET_FULL	Left	-1	0	-114
	Right	-1	0	38
LL OFFSET_MAIN	Left	-1	0	-120
	Right	-1	0	34
LL OFFSET_BACK	Left	0	0	6
	Right	0	0	3
WS O DEG	Left	0	19	-79
	Right	0	19	79
WS 15 DEG	Left	1	18	-70
	Right	0	18	76
WS 30 DEG	Left	2	16	-61
	Right	1	16	72
WS 45 DEG	Left	2	12	-43
	Right	2	12	59

CR+SH+PT (EOC)		
20	0	50
20	0	50

CR+SH+PT (D10K)		
29	0	5
29	0	5

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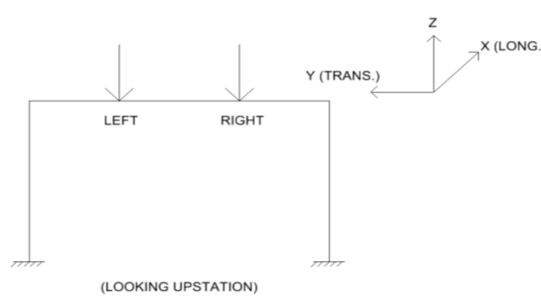
Tallahassee Denver Philadelphia Dallas	Designed: EDL	Project No.: 2262.03	Sheet of	
	Checked: MF	Date: 03-Oct-16		

LOADS @ BEARINGS
PIER 1 (SOUTH END)

	Bearing	FX (kips)	FY (kips)	FZ (kips)	Strength V (x 3.25)			Service I (x 3.33)		
WS 60 DEG	Left	3	7	-20						
	Right	2	7	41						
WS -15 DEG	Left	0	18	-76						
	Right	-1	18	70						
WS -30 DEG	Left	-1	16	-72						
	Right	-2	16	61						
WS -45 DEG	Left	-2	12	-60						
	Right	-2	12	43						
WS -60 DEG	Left	-2	7	-41						
	Right	-3	7	20						
WS O DEG_70 MPH	Left	0	8	-26	1	26	-85	1	27	-87
	Right	0	8	26	-1	26	85	-1	27	87
WS 15 DEG_70 MPH	Left	0	7	-23	1	24	-75	1	25	-77
	Right	0	7	25	0	24	80	0	25	82
WS 30 DEG_70 MPH	Left	1	7	-21	2	23	-67	2	23	-68
	Right	0	7	24	1	23	77	1	23	79
WS 45 DEG_70 MPH	Left	1	5	-14	3	16	-46	3	17	-48
	Right	1	5	19	2	16	61	2	17	62
WS 60 DEG_70 MPH	Left	1	3	-7	3	9	-23	3	9	-23
	Right	1	3	12	3	9	40	3	9	41
WS -15 DEG_70 MPH	Left	0	7	-25	0	24	-80	0	25	-82
	Right	0	7	23	-1	24	75	-1	25	77
WS -30 DEG_70 MPH	Left	0	7	-24	-1	23	-77	-1	23	-79
	Right	-1	7	20	-2	23	67	-2	23	68
WS -45 DEG_70 MPH	Left	-1	5	-19	-2	16	-61	-2	17	-62
	Right	-1	5	14	-3	16	46	-3	17	48
WS -60 DEG_70 MPH	Left	-1	3	-12	-3	9	-40	-3	9	-41
	Right	-1	3	7	-3	9	23	-3	9	23
WS+WUP	Left	1	19	-97						
	Right	0	19	151						
TU+	Left	-10	0	-35						
	Right	-10	0	-35						
TU-	Left	10	0	35						
	Right	10	0	35						
TU + TEMP. DIFF.	Left	-11	0	-69						
	Right	-11	0	-69						



Notes:
1. Loads are unfactored.
2. LL Offset load case considers pedestrian live load
3. The 70 mph wind load cases apply to Service I and
4. (-) for axial bearing load denotes compression.

Sum-It: AASHTO LRFD Load Combination Generator
Figg Bridge Engineers, Inc.
Combined Limit States Results
File Name: Pier 1 Bearing Reactions.sum

Selected Limit States

STR 1 - STRENGTH I
STR 3 - STRENGTH III
STR 5 - STRENGTH V

	Combined Results										
	Max/ Min ID	**Combo ID**	**Fx (kips)**	**Fy (kips)**	**Fz (kips)**	**Mx (ft*kip)**	**My (ft*kip)**	**Mz (ft*kip)**	**Mxy (ft*kip)**	**Mxz (ft*kip)**	**Myz (ft*kip)**
	Max Fx	STR 3/ 159	29.2	10.7	-447.4	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fy	STR 3/ 5	12.5	27.9	-644.6	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fz	STR 1/ 165	16.0	0.9	-339.1	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mx	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max My	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
Load No.	Max Mz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
1	Max Mxy	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
Member	Max Myz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
Left	Min Fx	STR 5/ 193	-1.9	4.9	-718.1	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fy	STR 1/ 55	14.3	0.9	-507.4	0.0	0.0	0.0	0.0	0.0	0.0
Joint	Min Fz	STR 1/ 53	9.3	1.3	-841.0	0.0	0.0	0.0	0.0	0.0	0.0
Left	Min Mx	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min My	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxy	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Myz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fx	STR 3/ 158	27.8	17.7	-336.8	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fy	STR 3/ 5	12.5	27.9	-423.4	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fz	STR 3/ 190	16.0	27.5	-145.2	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mx	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max My	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
Load No.	Max Mz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
2	Max Mxy	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
Member	Max Myz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
Right	Min Fx	STR 3/ 24	-2.2	11.1	-558.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fy	STR 1/ 55	14.3	0.9	-507.4	0.0	0.0	0.0	0.0	0.0	0.0
Joint	Min Fz	STR 1/ 47	7.5	1.3	-781.5	0.0	0.0	0.0	0.0	0.0	0.0
Right	Min Mx	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min My	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxy	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Myz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0

Sum-It: AASHTO LRFD Load Combination Generator
Figg Bridge Engineers, Inc.
Combined Limit States Results
File Name: Pier 1 Bearing Reactions.sum

Selected Limit States

SRV 1 - SERVICE I
SRV 3 - SERVICE III

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	SRV 1/ 309	29.9	6.1	-460.4	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fy	SRV 1/ 37	19.3	9.1	-494.1	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fz	SRV 3/ 7	20.0	1.0	-384.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mx	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
	Max My	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
Load No.	Max Mz	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
1	Max Mxy	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxz	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
Member	Max Myz	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
Left	Min Fx	SRV 1/ 193	-3.9	3.7	-594.3	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fy	SRV 3/ 1	19.2	1.0	-452.8	0.0	0.0	0.0	0.0	0.0	0.0
Joint	Min Fz	SRV 1/ 446	7.3	9.1	-687.1	0.0	0.0	0.0	0.0	0.0	0.0
Left	Min Mx	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
	Min My	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mz	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxy	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxz	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
	Min Myz	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fx	SRV 1/ 318	29.9	3.7	-433.7	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fy	SRV 1/ 37	18.7	9.1	-441.9	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fz	SRV 1/ 38	18.7	9.1	-327.9	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mx	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
	Max My	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
Load No.	Max Mz	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
2	Max Mxy	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxz	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
Member	Max Myz	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
Right	Min Fx	SRV 1/ 184	-3.9	6.1	-567.6	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fy	SRV 3/ 1	19.2	1.0	-452.8	0.0	0.0	0.0	0.0	0.0	0.0
Joint	Min Fz	SRV 1/ 436	5.1	3.7	-620.1	0.0	0.0	0.0	0.0	0.0	0.0
Right	Min Mx	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
	Min My	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mz	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxy	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxz	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
	Min Myz	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0

End Diaphragm - Type I

Ref. AASHTO LRFD (2012) 5.6.3

Parameters

$l_b := 3ft + 4in$	Length of bearing pad
$d_b := 1.410in$	Diameter of bar used for tension tie
$A_b := 1.56in^2$	Area of bar used for tension tie
$b := 3ft + 6in$	Width of section
$d := 3ft + 3.5in$	Distance from compression face to centroid of tension tie
$h := 4ft$	Least height of component section
$\alpha_s := 39deg$	Angle between compressive strut and tension tie
$P_{str} := 841 \cdot kip$	Factored bearing reaction (Strength)
$P_{srv} := 687 \cdot kip$	Factored bearing reaction (Service)
$f_c := 8.5ksi$	Specified compressive strength of concrete
$f_y := 60ksi$	Specified yield strength of reinforcement
$E_s := 29000ksi$	Modulus of elasticity of steel
$\phi_t := 0.9$	Resistance factor for tension-controlled reinforced concrete
$\phi_c := 0.7$	Resistance factor for compression in strut-and-tie models

Strut & Tie Model

Force in compressive strut:

$$F_c := \frac{P_{str}}{\sin(\alpha_s)} \qquad F_c = 1336 \cdot kip$$

Force in tension tie:

$$F_T := F_c \cdot \cos(\alpha_s) \qquad F_T = 1039 \cdot kip$$

Tension Tie (AASHTO LRFD 5.6.3.4)

Steel area required for tension tie (Strength):

$$A_{sreq\_str} := \frac{F_T}{\phi_t \cdot f_y}$$

$A_{sreq\_str} = 19.23 \cdot in^2$ Total area of longitudinal mild steel reinforcement required in tie

Steel area required for tension tie (Service):

$$A_{sreq\_srv} := \frac{F_T \cdot P_{srv}}{0.6 \cdot f_y \cdot P_{str}}$$

$A_{sreq\_srv} = 23.57 \cdot in^2$ Total area of longitudinal mild steel reinforcement required in tie

$A_{sprov} := 16 \cdot A_b$

$A_{sprov} = 24.96 \cdot in^2$

$$CHECK1 := \begin{cases} \text{"OK"} & \text{if } A_{sprov} \geq \max(A_{sreq\_str}, A_{sreq\_srv}) \\ \text{"NG"} & \text{otherwise} \end{cases}$$

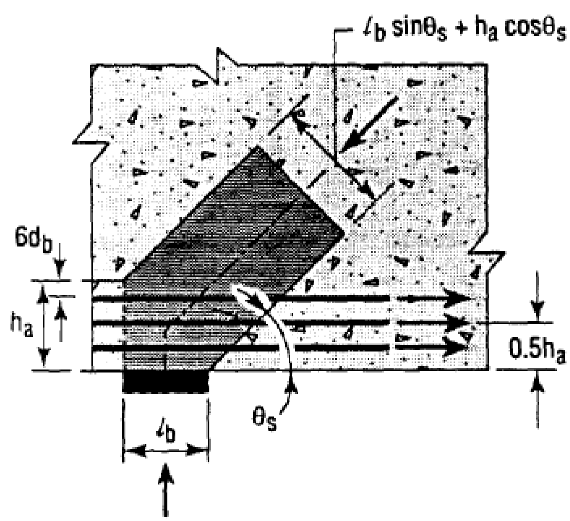
CHECK1 = "OK"

Tension development length (AASHTO LRFD 5.11.2.1.1):

$$L_d := \max\left[\frac{1.25 \cdot A_b \cdot f_y}{\sqrt{f_c \cdot ksi} \cdot in}, \frac{(0.4 \cdot d_b \cdot f_y)}{ksi}\right]$$

$L_d = 40.13 \cdot in$ Tension force shall be developed at the inner face of the nodal zone

Compressive Strut (AASHTO LRFD 5.6.3.3)



b) Strut anchored by bearing and reinforcement

Compressive stress in strut :

$h_a := 10in + 0.5 \cdot d_b + 6d_b$

$h_a = 19.16 \cdot in$ Height of anchorage zone

$d_{cs} := l_b \cdot \sin(\alpha_s) + h_a \cdot \cos(\alpha_s)$

$d_{cs} = 40.07 \cdot in$ Figure 5.6.3.3.2-1(b)

$A_{cs} := d_{cs} \cdot b$ | $A_{cs} = 1683 \cdot in^2$ | Effective cross-sectional area of strut

$\sigma_s := \dfrac{F_T}{A_{sprov}}$ | $\sigma_s = 42 \cdot ksi$ | Stress in tension tie due to factored loads

$\varepsilon_s := \dfrac{\sigma_s}{E_s}$ | $\varepsilon_s = 0.0014$ | Tensile strain in direction of tension tie due to factored loads

$\varepsilon_1 := \varepsilon_s + (\varepsilon_s + 0.002) \cdot \cot(\alpha_s)^2$ | $\varepsilon_1 = 0.0067$ | Equation 5.6.3.3.3-2

$f_{cu} := \min\left(\dfrac{f_c}{0.8 + 170 \cdot \varepsilon_1}, 0.85 \cdot f_c\right)$ | $f_{cu} = 4.39 \cdot ksi$ | Equation 5.6.3.3.3-1

$P_n := f_{cu} \cdot A_{cs}$ | $P_n = 7395 \cdot kip$ | Equation 5.6.3.3.1-1

$\phi P_n := \phi_c \cdot P_n$ | $\phi P_n = 5176 \cdot kip$ | Factored resistance of strut

$\dfrac{\phi P_n}{F_c} = 3.87$ | Demand / Capacity ratio

$$CHECK2 := \begin{cases} \text{"OK"} & \text{if } \phi P_n \ge F_c \\ \text{"NG"} & \text{otherwise} \end{cases}$$

$CHECK2 = \text{"OK"}$

Node Regions (AASHTO LRFD 5.6.3.5)

Distribution of tension tie reinforcement:

$f_{cn} := 0.75 \cdot \phi_c \cdot f_c$ | $f_{cn} = 4.46 \cdot ksi$ | Limiting concrete compressive stress in node region anchoring a one-direction tension tie

$A_{creq} := \dfrac{F_T}{f_{cn}}$ | $A_{creq} = 233 \cdot in^2$ | Required effective area of concrete

$b_{req} := \dfrac{A_{creq}}{h_a}$ | $b_{req} = 12.14 \cdot in$ | Required width of concrete strip in which tension tie reinforcement is distributed

$$CHECK3 := \begin{cases} \text{"OK"} & \text{if } b \ge b_{req} \\ \text{"NG"} & \text{otherwise} \end{cases}$$

$CHECK3 = \text{"OK"}$

Crack Control Reinforcement (AASHTO LRFD 5.6.3.6)

$s_{max} := \min\left(12in, \frac{d}{4}\right)$ — $s_{max} = 10 \cdot in$ — Maximum spacing of crack control reinforcement

Vertical reinforcement:

$A_v := 0.003 \cdot 12in \cdot b$ — $A_v = 1.51 \cdot in^2$ — Total area of vertical crack control reinforcement required per foot

Try 2-#9 bundled @ 18" max. (2 legs):

$A_{v\_prov} := 2 \cdot 2.00in^2 \cdot \left(\frac{12in}{18in}\right)$ — $A_{v\_prov} = 2.67 \cdot in^2$ — Total area of vertical crack control reinforcement provided per foot

$CHECK4 := \begin{cases} \text{"OK"} & \text{if } A_{v\_prov} \geq A_v \\ \text{"NG"} & \text{otherwise} \end{cases}$ — $CHECK4 = \text{"OK"}$

Horizontal reinforcement:

$A_h := 0.003 \cdot 12in \cdot b$ — $A_h = 1.51 \cdot in^2$ — Total area of horizontal crack control reinforcement required per foot

Try #8 @ 10" max. (each face):

$A_{h\_prov} := 2 \cdot 0.79in^2 \cdot \left(\frac{12in}{10in}\right)$ — $A_{h\_prov} = 1.90 \cdot in^2$ — Total area of horizontal crack control reinforcement provided per foot

$CHECK5 := \begin{cases} \text{"OK"} & \text{if } A_{h\_prov} \geq A_h \\ \text{"NG"} & \text{otherwise} \end{cases}$ — $CHECK5 = \text{"OK"}$

Spacing of vertical reinforcement exceeds maximum due to PT anchorage locations. Therefore, check estimated resistance at which diagonal cracks begin to form per 2016 Interim Revisions to AASHTO LRFD 7th Edition (2014) Equation C5.6.3.2-1.

$a := 60in$ — Shear span

$V_{cr1} := \left[0.2 - 0.1\left(\frac{a}{d}\right)\right] \cdot \sqrt{\frac{f_c}{ksi}} \cdot b \cdot d \cdot ksi$ — $V_{cr1} = 233 \cdot kip$

$V_{cr\_max} := 0.158 \cdot \sqrt{\frac{f_c}{ksi}} \cdot b \cdot d \cdot ksi$ — $V_{cr\_max} = 764 \cdot kip$

$V_{cr\_min} := 0.0632 \cdot \sqrt{\frac{f_c}{ksi}} \cdot b \cdot d \cdot ksi$ — $V_{cr\_min} = 306 \cdot kip$

$V_{cr} := \max\left(V_{cr1}, V_{cr\_min}\right)$ — $V_{cr} = 306 \cdot kip$

$V_{cr} := \min\left(V_{cr}, V_{cr\_max}\right)$ — $V_{cr} = 306 \cdot kip$ — Estimated resistance at which diagonal cracks begin to form

$V_{srv} := P_{srv} - 5 \cdot 81kip - 51kip$

$V_{srv} = 231 \cdot kip$ Service level shear including vertical component of PT

$$CHECK6 := \begin{cases} \text{"OK"} & \text{if } V_{srv} \le V_{cr} \\ \text{"NG"} & \text{otherwise} \end{cases}$$

$CHECK6 = \text{"OK"}$

Shrinkage & Temperature Reinforcement (AASHTO LRFD 5.10.8)

$$A_s := \max\left[\frac{(1.3b \cdot h \cdot ksi \cdot in)}{2(b+h) \cdot f_y}, 0.11in^2\right]$$

$A_s = 0.24 \cdot in^2$ Minimum area of reinforcement in each direction and in each face per foot

Try #5 @ 12":

$A_{s\_prov} := 0.31in^2$

$$CHECK7 := \begin{cases} \text{"OK"} & \text{if } A_{s\_prov} \ge A_s \\ \text{"NG"} & \text{otherwise} \end{cases}$$

$CHECK7 = \text{"OK"}$

LOADS @ BEARINGS
PIER 3 (NORTH END)

	Bearing	FX (kips)	FY (kips)	FZ (kips)
DC_EOC	Left	1	0	-333
	Right	1	0	-333
CR_EOC	Left	-4	0	16
	Right	-4	0	16
SH_EOC	Left	-1	0	-6
	Right	-1	0	-6
PT_EOC	Left	-6	0	70
	Right	-6	0	70
DC_D10K	Left	1	0	-333
	Right	1	0	-333
CR_D10K	Left	-6	0	21
	Right	-6	0	21
SH_D10K	Left	-5	0	-98
	Right	-5	0	-98
PT_D10K	Left	-5	0	75
	Right	-5	0	75
DW	Left	0	0	-5
	Right	0	0	-5
LL DECK_FULL	Left	-1	0	-19
	Right	-1	0	-19
LL DECK_MAIN	Left	-1	0	52
	Right	-1	0	52
LL DECK_BACK	Left	0	0	-71
	Right	0	0	-71
LL ROOF_FULL	Left	0	0	0
	Right	0	0	0
LL ROOF_MAIN	Left	0	0	6
	Right	0	0	6
LL ROOF_BACK	Left	0	0	-6
	Right	0	0	-6
LL OFFSET_FULL	Left	0	0	-61
	Right	0	0	42
LL OFFSET_MAIN	Left	0	0	32
	Right	0	0	20
LL OFFSET_BACK	Left	0	0	-93
	Right	0	0	22
WS 0 DEG	Left	0	1	-48
	Right	0	1	48
WS 15 DEG	Left	1	1	-50
	Right	0	1	39
WS 30 DEG	Left	1	1	-52
	Right	1	1	29
WS 45 DEG	Left	2	1	-48
	Right	2	1	15

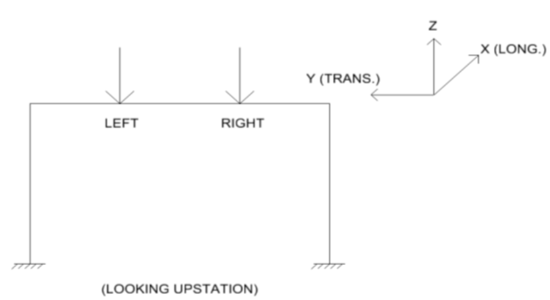
CR+SH+PT (EOC)		
-11	0	80
-11	0	80

CR+SH+PT (D10K)		
-17	0	-1
-17	0	-1

Figg Bridge Engineers, Inc.	Project: FIU - Pedestrian Bridge			Creating Bridges as Art
	Designed: EDL	Project No.: 2262.03	Sheet of	
Tallahassee Denver Philadelphia Dallas	Checked: MF	Date: 03-Oct-16		

LOADS @ BEARINGS
PIER 3 (NORTH END)

	Bearing	FX (kips)	FY (kips)	FZ (kips)	Strength V (x 3.25)			Service I (x 3.33)		
WS 60 DEG	Left	2	1	-39						
	Right	2	1	-1						
WS -15 DEG	Left	0	1	-38						
	Right	-1	1	49						
WS -30 DEG	Left	-1	1	-28						
	Right	-1	1	51						
WS -45 DEG	Left	-2	1	-14						
	Right	-2	1	48						
WS -60 DEG	Left	-2	1	1						
	Right	-2	1	39						
WS O DEG_70 MPH	Left	0	0	-14	0	0	-47	0	0	-48
	Right	0	0	14	0	0	47	0	0	48
WS 15 DEG_70 MPH	Left	0	0	-15	1	0	-48	1	0	-49
	Right	0	0	12	0	0	38	1	0	39
WS 30 DEG_70 MPH	Left	1	0	-16	2	0	-51	2	0	-52
	Right	0	0	9	1	0	29	1	0	29
WS 45 DEG_70 MPH	Left	1	0	-14	3	0	-46	3	0	-47
	Right	1	0	4	2	0	15	2	0	15
WS 60 DEG_70 MPH	Left	1	0	-11	3	0	-37	3	0	-38
	Right	1	0	0	3	0	-1	3	0	-1
WS -15 DEG_70 MPH	Left	0	0	-12	0	0	-38	-1	0	-39
	Right	0	0	15	-1	0	48	-1	0	49
WS -30 DEG_70 MPH	Left	0	0	-9	-1	0	-29	-1	0	-30
	Right	-1	0	16	-2	0	50	-2	0	52
WS -45 DEG_70 MPH	Left	-1	0	-5	-2	0	-15	-2	0	-15
	Right	-1	0	14	-3	0	46	-3	0	47
WS -60 DEG_70 MPH	Left	-1	0	0	-3	0	1	-3	0	1
	Right	-1	0	11	-3	0	37	-3	0	38
WS+WUP	Left	0	1	-69						
	Right	0	1	78						
TU+	Left	6	0	-64						
	Right	6	0	-64						
TU-	Left	-6	0	64						
	Right	-6	0	64						
TU + TEMP. DIFF.	Left	6	0	-124						
	Right	6	0	-124						



Notes:
1. Loads are unfactored.
2. LL Offset load case considers pedestrian live load
3. The 70 mph wind load cases apply to Service I and
4. (-) for axial bearing load denotes compression.

Sum-It: AASHTO LRFD Load Combination Generator
Figg Bridge Engineers, Inc.
Combined Limit States Results
File Name: Pier 3 Bearing Reactions.sum

Selected Limit States

STR 1 - STRENGTH I
STR 3 - STRENGTH III
STR 5 - STRENGTH V

	Combined Results										
	Max/ Min ID	**Combo ID**	**Fx (kips)**	**Fy (kips)**	**Fz (kips)**	**Mx (ft*kip)**	**My (ft*kip)**	**Mz (ft*kip)**	**Mxy (ft*kip)**	**Mxz (ft*kip)**	**Myz (ft*kip)**
	Max Fx	STR 3/ 18	-4.0	1.4	-443.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fy	STR 3/ 1	-12.8	1.4	-365.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fz	STR 1/ 164	-14.9	0.0	-100.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mx	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max My	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
Load No.	Max Mz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
1	Max Mxy	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
Member	Max Myz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
Left	Min Fx	STR 3/ 153	-21.9	1.4	-295.8	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fy	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
Joint	Min Fz	STR 1/ 54	-12.8	0.0	-649.5	0.0	0.0	0.0	0.0	0.0	0.0
Left	Min Mx	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min My	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxy	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Myz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fx	STR 3/ 18	-4.0	1.4	-354.8	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fy	STR 3/ 1	-14.2	1.4	-243.2	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fz	STR 3/ 190	-13.1	1.4	-81.8	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mx	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max My	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
Load No.	Max Mz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
2	Max Mxy	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
Member	Max Myz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
Right	Min Fx	STR 3/ 153	-21.9	1.4	-209.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fy	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
Joint	Min Fz	STR 1/ 48	-12.8	0.0	-611.0	0.0	0.0	0.0	0.0	0.0	0.0
Right	Min Mx	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min My	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxy	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Myz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0

Sum-It: AASHTO LRFD Load Combination Generator
Figg Bridge Engineers, Inc.
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Selected Limit States

SRV 1 - SERVICE I
SRV 3 - SERVICE III

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	SRV 1/ 146	-3.1	0.0	-397.1	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fy	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fz	SRV 1/ 31	-17.9	0.0	-141.7	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mx	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
	Max My	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
Load No.	Max Mz	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
1	Max Mxy	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxz	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
Member	Max Myz	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
Left	Min Fx	SRV 1/ 271	-23.9	0.0	-293.7	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fy	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
Joint	Min Fz	SRV 1/ 467	-9.4	0.0	-571.6	0.0	0.0	0.0	0.0	0.0	0.0
Left	Min Mx	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
	Min My	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mz	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxy	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxz	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
	Min Myz	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fx	SRV 1/ 155	-3.1	0.0	-280.3	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fy	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fz	SRV 1/ 13	-17.6	0.0	-126.4	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mx	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
	Max My	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
Load No.	Max Mz	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
2	Max Mxy	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxz	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
Member	Max Myz	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
Right	Min Fx	SRV 1/ 262	-23.9	0.0	-279.9	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fy	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
Joint	Min Fz	SRV 1/ 484	-9.1	0.0	-534.3	0.0	0.0	0.0	0.0	0.0	0.0
Right	Min Mx	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
	Min My	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mz	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxy	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxz	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
	Min Myz	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0

End Diaphragm - Type IV

Ref. AASHTO LRFD (2012) 5.6.3

Parameters

$l_b := 3ft + 4in$	Length of bearing pad
$d_b := 1.410in$	Diameter of bar used for tension tie
$A_b := 1.56in^2$	Area of bar used for tension tie
$b := 5ft$	Width of section
$d := 3ft + 5.5in$	Distance from compression face to centroid of tension tie
$h := 4ft$	Least height of component section
$\alpha_s := 39deg$	Angle between compressive strut and tension tie
$P_{str} := 650 \cdot kip$	Factored bearing reaction (Strength)
$P_{srv} := 572 \cdot kip$	Factored bearing reaction (Service)
$f_c := 8.5ksi$	Specified compressive strength of concrete
$f_y := 60ksi$	Specified yield strength of reinforcement
$E_s := 29000ksi$	Modulus of elasticity of steel
$\phi_t := 0.9$	Resistance factor for tension-controlled reinforced concrete
$\phi_c := 0.7$	Resistance factor for compression in strut-and-tie models

Strut & Tie Model

Force in compressive strut:

$$F_c := \frac{P_{str}}{\sin(\alpha_s)} \qquad F_c = 1033 \cdot kip$$

Force in tension tie:

$$F_T := F_c \cdot \cos(\alpha_s) \qquad F_T = 803 \cdot kip$$

Tension Tie (AASHTO LRFD 5.6.3.4)

Steel area required for tension tie (Strength):

$$A_{sreq\_str} := \frac{F_T}{\phi_t \cdot f_y}$$

$A_{sreq\_str} = 14.86 \cdot in^2$ Total area of longitudinal mild steel reinforcement required in tie

Steel area required for tension tie (Service):

$$A_{sreq\_srv} := \frac{F_T \cdot P_{srv}}{0.6 \cdot f_y \cdot P_{str}}$$

$A_{sreq\_srv} = 19.62 \cdot in^2$ Total area of longitudinal mild steel reinforcement required in tie

$A_{sprov} := 14 \cdot A_b$

$A_{sprov} = 21.84 \cdot in^2$

$$CHECK1 := \begin{cases} \text{"OK"} & \text{if } A_{sprov} \geq \max(A_{sreq\_str}, A_{sreq\_srv}) \\ \text{"NG"} & \text{otherwise} \end{cases}$$

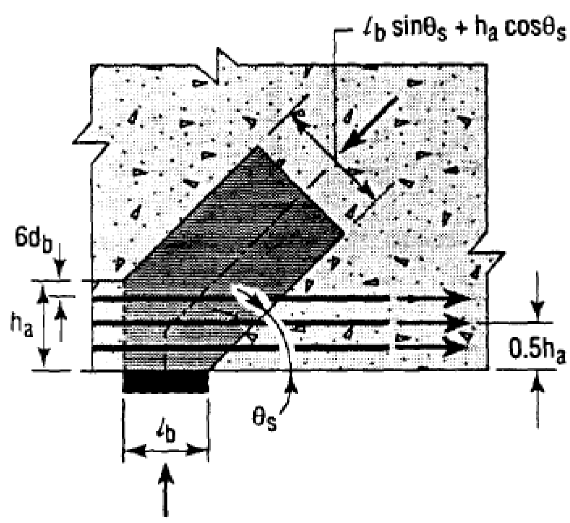
$CHECK1 = \text{"OK"}$

Tension development length (AASHTO LRFD 5.11.2.1.1):

$$L_d := \max\left[\frac{1.25 \cdot A_b \cdot f_y}{\sqrt{f_c \cdot ksi} \cdot in}, \frac{(0.4 \cdot d_b \cdot f_y)}{ksi}\right]$$

$L_d = 40.13 \cdot in$ Tension force shall be developed at the inner face of the nodal zone

Compressive Strut (AASHTO LRFD 5.6.3.3)



b) Strut anchored by bearing and reinforcement

Compressive stress in strut :

$h_a := 8in + 0.5d_b + 6d_b$

$h_a = 17.17 \cdot in$ Height of anchorage zone

$d_{cs} := l_b \cdot \sin(\alpha_s) + h_a \cdot \cos(\alpha_s)$

$d_{cs} = 38.51 \cdot in$ Figure 5.6.3.3.2-1(b)

$A_{cs} := d_{cs} \cdot b$	$A_{cs} = 2311 \cdot in^2$	Effective cross-sectional area of strut
$\sigma_s := \dfrac{F_T}{A_{sprov}}$	$\sigma_s = 37 \cdot ksi$	Stress in tension tie due to factored loads
$\varepsilon_s := \dfrac{\sigma_s}{E_s}$	$\varepsilon_s = 0.0013$	Tensile strain in direction of tension tie due to factored loads
$\varepsilon_1 := \varepsilon_s + (\varepsilon_s + 0.002) \cdot \cot(\alpha_s)^2$	$\varepsilon_1 = 0.0062$	Equation 5.6.3.3.3-2
$f_{cu} := \min\left(\dfrac{f_c}{0.8 + 170 \cdot \varepsilon_1}, 0.85 \cdot f_c\right)$	$f_{cu} = 4.56 \cdot ksi$	Equation 5.6.3.3.3-1
$P_n := f_{cu} \cdot A_{cs}$	$P_n = 10546 \cdot kip$	Equation 5.6.3.3.1-1
$\phi P_n := \phi_c \cdot P_n$	$\phi P_n = 7382 \cdot kip$	Factored resistance of strut
$\dfrac{\phi P_n}{F_c} = 7.15$		Demand / Capacity ratio

$$CHECK2 := \begin{cases} \text{"OK"} & \text{if } \phi P_n \geq F_c \\ \text{"NG"} & \text{otherwise} \end{cases}$$

$CHECK2 = \text{"OK"}$

Node Regions (AASHTO LRFD 5.6.3.5)

Distribution of tension tie reinforcement:

$f_{cn} := 0.75 \cdot \phi_c \cdot f_c$	$f_{cn} = 4.46 \cdot ksi$	Limiting concrete compressive stress in node region anchoring a one-direction tension tie
$A_{creq} := \dfrac{F_T}{f_{cn}}$	$A_{creq} = 180 \cdot in^2$	Required effective area of concrete
$b_{req} := \dfrac{A_{creq}}{h_a}$	$b_{req} = 10.48 \cdot in$	Required width of concrete strip in which tension tie reinforcement is distributed

$$CHECK3 := \begin{cases} \text{"OK"} & \text{if } b \geq b_{req} \\ \text{"NG"} & \text{otherwise} \end{cases}$$

$CHECK3 = \text{"OK"}$

Crack Control Reinforcement (AASHTO LRFD 5.6.3.6)

$s_{max} := \min\left(12in, \frac{d}{4}\right)$ $\qquad s_{max} = 10 \cdot in$ Maximum spacing of crack control reinforcement

Vertical reinforcement:

$A_v := 0.003 \cdot 12in \cdot b$ $\qquad A_v = 2.16 \cdot in^2$ Total area of vertical crack control reinforcement required per foot

Try #9 @ 10" max. (2 legs):

$A_{v\_prov} := 2 \cdot 1.00in^2 \cdot \left(\frac{12in}{10in}\right)$ $\qquad A_{v\_prov} = 2.40 \cdot in^2$ Total area of vertical crack control reinforcement provided per foot

$$CHECK4 := \begin{cases} \text{"OK"} & \text{if } A_{v\_prov} \geq A_v \\ \text{"NG"} & \text{otherwise} \end{cases}$$

$CHECK4 = \text{"OK"}$

Horizontal reinforcement:

$A_h := 0.003 \cdot 12in \cdot b$ $\qquad A_h = 2.16 \cdot in^2$ Total area of horizontal crack control reinforcement required per foot

Try #8 @ 8" max. (each face):

$A_{h\_prov} := 2 \cdot 0.79in^2 \cdot \left(\frac{12in}{8in}\right)$ $\qquad A_{h\_prov} = 2.37 \cdot in^2$ Total area of horizontal crack control reinforcement provided per foot

$$CHECK5 := \begin{cases} \text{"OK"} & \text{if } A_{h\_prov} \geq A_h \\ \text{"NG"} & \text{otherwise} \end{cases}$$

$CHECK5 = \text{"OK"}$

Shrinkage & Temperature Reinforcement (AASHTO LRFD 5.10.8)

$A_s := \max\left[\frac{(1.3b \cdot h \cdot ksi \cdot in)}{2(b + h) \cdot f_y}, 0.11in^2\right]$ $\qquad A_s = 0.29 \cdot in^2$ Minimum area of reinforcement in each direction and in each face per foot

Try #5 @ 12":

$A_{s\_prov} := 0.31in^2$

$$CHECK6 := \begin{cases} \text{"OK"} & \text{if } A_{s\_prov} \geq A_s \\ \text{"NG"} & \text{otherwise} \end{cases}$$

$CHECK6 = \text{"OK"}$

JACK SIZING – END DIAPHRAGM 1

Conservatively, assume no reduction in live load or wind speed.

From SumIt, maximum Service reaction = 687 kips

Try two 250 ton jacks per bearing (Enerpac CLP-2502). Use 75% of jack capacity for design.
Jack capacity = 2(250 tons)(2 kips/ton)(0.75) = 750 Kips > 687 Kips OK

CHECK TENSION TIE

$\alpha_s = 58^\circ > 39^\circ$ (permanent condition)

By inspection, permanent condition will govern.

CHECK BEARING ON BENT CAP – END DIAPHRAGM 1

$P_r = \phi P_n = \phi\, 0.85 f'_c A_1 m$ [AASHTO LRFD 5.7.5]

Assume bearing plate is the area of the jacks inscribed in a rectangle.
$A = 10.83 \text{ in } (2)(10.83 \text{ in}) = 235 \text{ in}^2$
Use $m = 2.0$.

$\phi P_n = 0.70(0.85)(5.5 \text{ ksi})(235 \text{ in}^2)(2) = 1538$ Kips

From SumIt, maximum Strength reaction = 841 Kips < 1538 Kips OK

* By inspection, End Diaphragm 4 loads are smaller. Therefore, End Diaphragm 1 design governs.

▼ Shown from left to right: **CLP-2002, CLP-5002**

The Shortest Power Lifter

Saddles

All CLP-Series cylinders include integral tilt saddles with maximum tilt angles up to 5°.

Gauges

Minimize the risk of overloading and ensure long, dependable service from your equipment. Refer to the System Components section for a full range of gauges.

Page: 113

Hoses

Enerpac offers a complete line of high-quality hydraulic hoses. To ensure the integrity of your system, specify only Enerpac hydraulic hoses.

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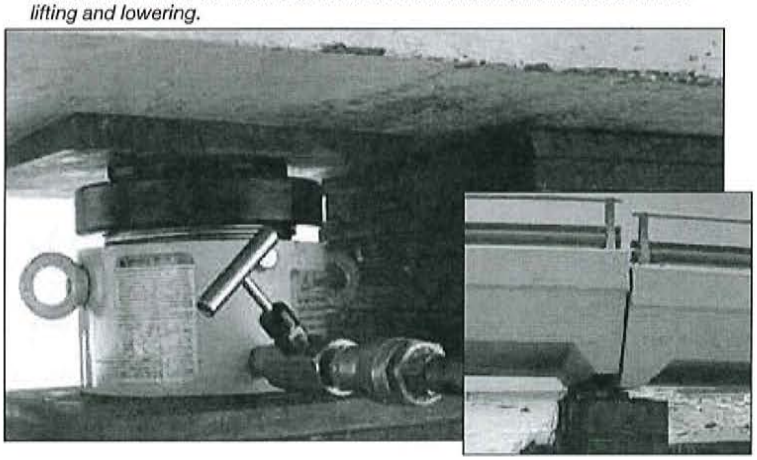
- **Flat design for use in confined areas**
- **Safety lock nut for mechanical load holding**
- **Single-acting load return**
- **Special bearing design resists sideload forces**
- **Overflow port functions as a stroke limiter**
- **CR-400 coupler and dust cap included on all models**

▼ *Only the extreme low height CLP-cylinder fits in this confined area to lift the construction. The V-82 needle valve is used to control cylinder speed during lifting and lowering.*



Cylinder Capacity (ton) [maximum]	Stroke (in)	Model Number	Cylinder Effective Area (in²)	Oil Capacity (in³)
60 [67.1]	1.97	**CLP-602**	13.42	26.42
100 [113.7]	1.97	**CLP-1002**	22.75	44.78
160 [179.2]	1.77	**CLP-1602**	35.85	63.51
200 [221.3]	1.77	**CLP-2002**	44.27	78.43
250 [284.2]	1.77	**CLP-2502**	56.85	100.72
400 [433.6]	1.77	**CLP-4002**	86.72	153.64
500 [566.2]	1.77	**CLP-5002**	113.25	200.63

Single-Acting, Pancake Lock Nut Cylinders

Speed Chart
See the Enerpac Cylinder Speed Chart in our "Yellow Pages" to determine your approximate cylinder speed.

Page: 251

Longer Stroke Lock Nut Cylinders
For lock nut applications that require longer stroke lengths, see **CLL-Series** cylinders.

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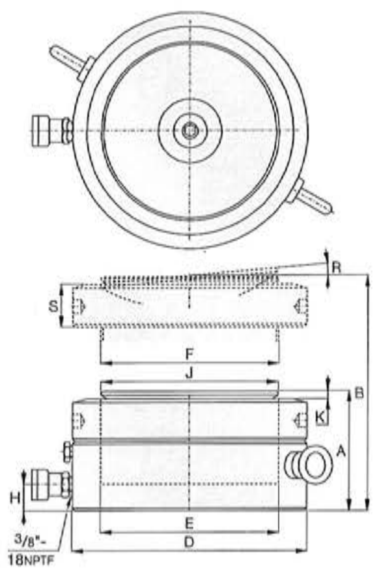
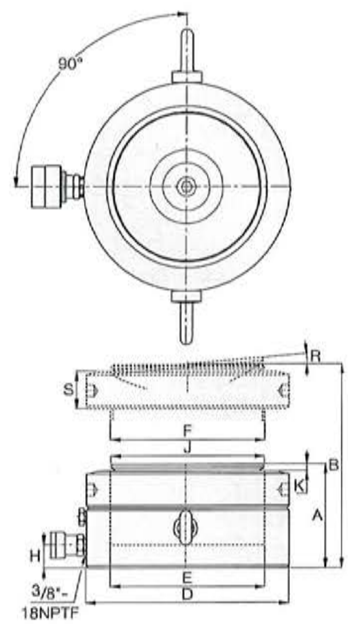
CLP Series

Capacity:
60-500 tons

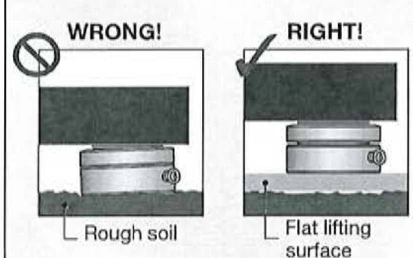
Stroke:
1.77-1.97 inches

Maximum Operating Pressure:
10,000 psi





All CLP-series cylinders require a solid lifting surface for correct support.
Use of pancake cylinders on surfaces such as sand, mud or dirt may result in cylinder damage!



For more safety instructions see our "Yellow Pages".

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Collapsed Height A (in)	Extended Height B (in)	Outside Diameter D (in)	Cyl. Bore Diameter E (in)	Plunger Diameter F (mm)	Base to Advance Port H (in)	Saddle Diameter J (in)	Saddle Protrusion from Plngr. K (in)	Saddle Max. Tilt Angle R	Lock Nut Height S (in)	Weight (lbs)	Model Number
4.92	6.89	5.51	4.13	Tr 104 x 4	.75	3.78	.24	5°	1.10	33	CLP-602
5.39	7.36	6.89	5.38	Tr 136 x 6	.83	4.96	.31	5°	1.22	57	CLP-1002
5.83	7.60	8.66	6.76	Tr 171 x 6	1.06	6.30	.35	5°	1.57	97	CLP-1602
6.10	7.87	9.65	7.51	Tr 190 x 6	1.18	7.09	.39	5°	1.69	125	CLP-2002
6.26	8.03	10.83	8.51	Tr 216 x 6	1.26	7.87	.43	5°	1.73	163	CLP-2502
7.01	8.78	13.78	10.51	Tr 266 x 6	1.54	9.84	.43	4°	2.17	295	CLP-4002
7.56	9.33	15.75	12.01	Tr 305 x 6	1.89	11.42	.39	3°	2.44	416	CLP-5002

FIGG

Project FIU PEDESTRIAN BRIDGE	Date 8/8/16	Page / Of
Project Number 2262.03	Designed ENH	
Description SHEAR FRICTION - END DIAPHRAGM 1+4	Checked	

SHEAR FRICTION BETWEEN DIAPHRAGM AND DECK - END DIAPHRAGM 1

$V_{ri} = \phi V_{ni} = \phi\left(cA_{cv} + \mu A_{vf} f_y\right)$ [AASHTO LRFD 5.8.4.1]

Conservatively neglect resistance of concrete.

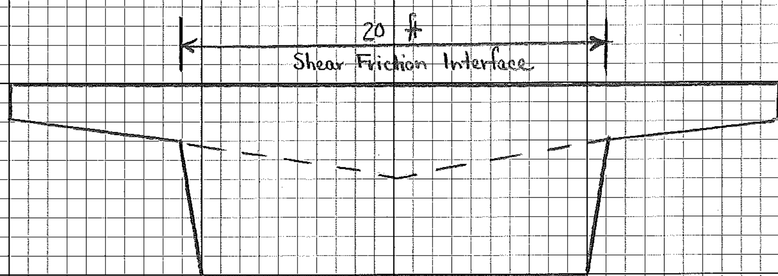
$\mu = 1.4$ for monolithic connection

Try #4 @ 12" (long. reinforcement) over 20'-0" section

$A_{vf} = 21\,(0.20\ in^2) = 4.20\ in^2$

$\phi V_{ni} = 0.9\,(1.4)(4.20\ in^2)(60\ ksi) = 317^k \gg V_u = 30^k$ OK

* By inspection, End Diaphragm 4 loads are smaller. Therefore, End Diaphragm 1 design governs.



CREATING BRIDGES AS ART®

	Project FIU PEDESTRIAN BRIDGE	Date 10/22/16	Page Of
FIGG	Project Number 2262.03	Designed ENH	
	Description DECK END DIAPHRAGM – TYPE IV	Checked	

CHECK TENSILE FORCE BETWEEN TWO GROUPS OF ANCHORAGES

From finite element model, tensile force due to PT = 62^k (for half of section)

Total tensile force = $2 \times 62^k = 124^k$

$A_{s,req} = \dfrac{124^k}{36\text{ ksi}} = 3.44\text{ in}^2$

Try 5 – #8 bars : $A_{s,prov} = 3.95\text{ in}^2 > 3.44\text{ in}^2$ OK

Provide same steel area for Type III diaphragm :

2 – #11 and 1 – #8 : $A_s = 2(1.56) + 0.79 = 3.91\text{ in}^2 > 3.44\text{ in}^2$ OK

FIGG	Project: FIU PEDESTRIAN BRIDGE	Date: 8/20/16	Page / Of
	Project Number: 2262.03	Designed: ENH	
	Description: END DIAPHRAGM 2+3	Checked:	

STRUT + TIE CHECK DURING CONSTRUCTION – END DIAPHRAGM 2 (CASTING)

Superstructure self weight = 950 tons including 2% allowance (see EDL's calcs)

$P = \frac{0.98\ (950\ \text{tons})}{2} \times 2\ ^{\text{kips}}/_{\text{ton}} = 931\ \text{Kips}$

Assume 2 bearings spaced 6'-0" apart. ($\alpha = 53°$)

$P_u = \frac{1}{2}(1.25)(931^K) = 582\ \text{Kips}$ (per bearing)

$P_S = \frac{1}{2}(1.00)(931^K) = 466\ \text{Kips}$ (per bearing)

See Strut + Tie Analysis Mathcad sheet.

CHECK BEARING AT PYLON / DIAPHRAGM INTERFACE – END DIAPHRAGM 2 (IN SERVICE)

Self-weight + barriers : $P_{DC} = 931^K + \frac{0.396\ ^K/_{ft}\ (175\ ft)}{2} = 966\ \text{Kips}$

Utilities : $P_{DW} = \frac{0.738\ ^K/_{ft}\ (175\ ft)}{2} = 65\ \text{Kips}$

$P_{LL} = 401\ \text{Kips}$ (see EDL's calcs)

$P_u = 1.25(966^K) + 1.50(65^K) + 1.75(401^K) = 2007\ \text{Kips}$

$P_r = \phi P_n = \phi\ 0.85 f'_c A_1 m$ [AASHTO LRFD 5.7.5]

$A_1 = 18.17\ ft\ (2\ ft)(12\ ^{in}/_{ft})^2 = 5233\ in^2$ (Conservatively consider only diaphragm area)

$\phi P_n = 0.70\ (0.85)(8.5\ ksi)(5233\ in^2)(1.0) = 26466\ \text{Kips} > 2007\ \text{Kips}$ OK

* See Top of Pylon Base Strut + Tie Analysis for End Diaphragm III (cast-in-place). Reinforcement is provided at the top of the pylon base.

Figg Bridge Engineers, Inc.	Project FIU - Pedestrian Bridge			Creating
	Designed EDL	Project No. 2262.03	Sheet of	Bridges
	Checked MF	Date 23-May-16		as Art

SUPERSTRUCTURE WEIGHT

Precast Main Span

w_c (lb/ft^3) 150 (Per SDG Table 2.2-1, for structural concrete)

Element	Area (ft^2)	L (ft)	Vol (ft^3)	Weight (kips)	Weight (tons)
Deck	45.80	174.88	8009.28	1201.39	601
Canopy	16.46	174.88	2878.44	431.77	216
Truss	-	-	-	145.16	73
Anchor Blisters	-	-	175.00	26.25	13
South End Deck Diaphragm	46.77	3.50	163.70	24.55	12
Pylon End Deck Diaphragm	46.77	2.88	134.46	20.17	10
South End Canopy Diaphragm	17.33	3.00	51.99	7.80	4
Pylon End Canopy Diaphragm	17.33	4.00	69.32	10.40	5
~2% Allowance	-	-	-	-	16
				Total	950

$$0.98 \times \frac{950 \text{ tons}}{2} \times 2 \frac{\text{Kips}}{\text{ton}} = 931 \text{ Kips}$$

Cast-in-Place Back Span

w_c (lb/ft^3) 150 (Per SDG Table 2.2-1, for structural concrete)

Element	Area (ft^2)	L (ft)	Vol (ft^3)	Weight (kips)	Weight (tons)
Deck	45.80	98.88	4528.48	679.27	340
Canopy	16.46	98.88	1627.48	244.12	122
Truss	-	-	-	120.82	60
Anchor Blisters	-	-	175.00	26.25	13
North End Deck Diaphragm	46.77	3.00	140.31	21.05	11
Pylon End Deck Diaphragm	46.77	2.88	134.46	20.17	10
North End Canopy Diaphragm	17.33	3.00	51.99	7.80	4
Pylon End Canopy Diaphragm	17.33	4.00	69.32	10.40	5
~2% Allowance	-	-	-	-	10
				Total	575

Note: An allowance of approximately 2% has been added to account for members connection details.

Figg Bridge Engineers, Inc.	Project FIU - Pedestrian Bridge			Creating
	Designed EDL	Project No. 2262.03	Sheet of	Bridges
	Checked	Date 23-May-16		as Art

Live Load At Pylon

Member	Joint	Result Case	Force X (kips)	Force Y (kips)	Force Z (kips)	Moment X (kips-ft)	Moment Y (kips-ft)	Moment Z (kips-ft)
201	2000	Live Load Main Span: LL2_Deck	4.86	0.33	-401.13	-0.31	-681.28	-4.58
201	2000	Live Load Back Span: LL3_Deck	-1.44	-0.27	-184.67	0.56	309.54	-4.53

End Diaphragm - Type II

Ref. AASHTO LRFD (2012) 5.6.3

Parameters

$l_b := 3ft + 4in$	Assumed length of bearing pad
$d_b := 1.410in$	Diameter of bar used for tension tie
$A_b := 1.56in^2$	Area of bar used for tension tie
$b := 2ft$	Width of section
$d := 3ft + 2.5in$	Distance from compression face to centroid of tension tie
$h := 4ft$	Least height of component section
$\alpha_s := 53deg$	Angle between compressive strut and tension tie (assuming bearings spaced 6'-0" apart)
$P_{str} := 582 \cdot kip$	Factored bearing reaction (Strength) (due to self weight during temporary condition)
$P_{srv} := 466 \cdot kip$	Factored bearing reaction (Service) (due to self weight during temporary condition)
$f_c := 8.5ksi$	Specified compressive strength of concrete
$f_y := 60ksi$	Specified yield strength of reinforcement
$E_s := 29000ksi$	Modulus of elasticity of steel
$\phi_t := 0.9$	Resistance factor for tension-controlled reinforced concrete
$\phi_c := 0.7$	Resistance factor for compression in strut-and-tie models

Strut & Tie Model

Force in compressive strut:

$$F_c := \frac{P_{str}}{\sin(\alpha_s)} \qquad F_c = 729 \cdot kip$$

Force in tension tie:

$$F_T := F_c \cdot \cos(\alpha_s) \qquad F_T = 439 \cdot kip$$

Tension Tie (AASHTO LRFD 5.6.3.4)

Steel area required for tension tie (Strength):

$$A_{sreq\_str} := \frac{F_T}{\phi_t \cdot f_y}$$

$A_{sreq\_str} = 8.12 \cdot in^2$ Total area of longitudinal mild steel reinforcement required in tie

Steel area required for tension tie (Service):

$$A_{sreq\_srv} := \frac{F_T \cdot P_{srv}}{0.6 \cdot f_y \cdot P_{str}}$$

$A_{sreq\_srv} = 9.75 \cdot in^2$ Total area of longitudinal mild steel reinforcement required in tie

$$A_{sprov} := 8 \cdot A_b$$

$A_{sprov} = 12.48 \cdot in^2$

$$CHECK1 := \begin{cases} \text{"OK"} & \text{if } A_{sprov} \geq \max(A_{sreq\_str}, A_{sreq\_srv}) \\ \text{"NG"} & \text{otherwise} \end{cases}$$

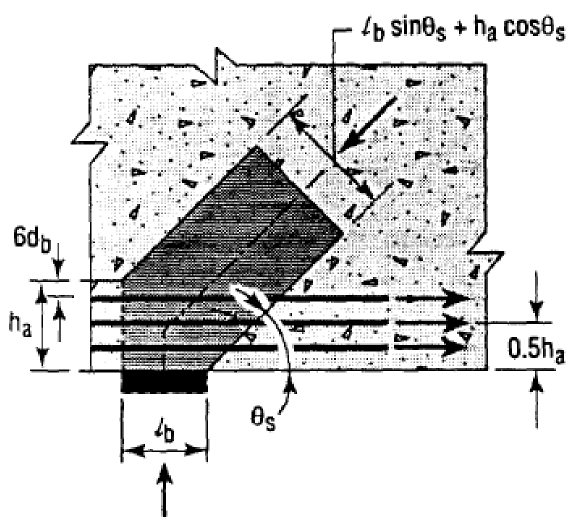
$CHECK1 = \text{"OK"}$

Tension development length (AASHTO LRFD 5.11.2.1.1):

$$L_d := \max\left[\frac{1.25 \cdot A_b \cdot f_y}{\sqrt{f_c \cdot ksi} \cdot in}, \frac{(0.4 \cdot d_b \cdot f_y)}{ksi}\right]$$

$L_d = 40.13 \cdot in$ Tension force shall be developed at the inner face of the nodal zone

Compressive Strut (AASHTO LRFD 5.6.3.3)



b) Strut anchored by bearing and reinforcement

Compressive stress in strut :

$$h_a := 12in + d_b + 6d_b$$

$h_a = 21.87 \cdot in$ Height of anchorage zone

$$d_{cs} := l_b \cdot \sin(\alpha_s) + h_a \cdot \cos(\alpha_s)$$

$d_{cs} = 45.11 \cdot in$ Figure 5.6.3.3.2-1(b)

$A_{cs} := d_{cs} \cdot b$ | $A_{cs} = 1083 \cdot in^2$ | Effective cross-sectional area of strut

$\sigma_s := \dfrac{F_T}{A_{sprov}}$ | $\sigma_s = 35 \cdot ksi$ | Stress in tension tie due to factored loads

$\varepsilon_s := \dfrac{\sigma_s}{E_s}$ | $\varepsilon_s = 0.0012$ | Tensile strain in direction of tension tie due to factored loads

$\varepsilon_1 := \varepsilon_s + (\varepsilon_s + 0.002) \cdot \cot(\alpha_s)^2$ | $\varepsilon_1 = 0.0030$ | Equation 5.6.3.3.3-2

$f_{cu} := \min\left(\dfrac{f_c}{0.8 + 170 \cdot \varepsilon_1}, 0.85 \cdot f_c\right)$ | $f_{cu} = 6.46 \cdot ksi$ | Equation 5.6.3.3.3-1

$P_n := f_{cu} \cdot A_{cs}$ | $P_n = 6992 \cdot kip$ | Equation 5.6.3.3.1-1

$\phi P_n := \phi_c \cdot P_n$ | $\phi P_n = 4894 \cdot kip$ | Factored resistance of strut

$\dfrac{\phi P_n}{F_c} = 6.72$ | Demand / Capacity ratio

$$CHECK2 := \begin{cases} \text{"OK"} & \text{if } \phi P_n \ge F_c \\ \text{"NG"} & \text{otherwise} \end{cases}$$

CHECK2 = "OK"

Node Regions (AASHTO LRFD 5.6.3.5)

Distribution of tension tie reinforcement:

$f_{cn} := 0.75 \cdot \phi_c \cdot f_c$ | $f_{cn} = 4.46 \cdot ksi$ | Limiting concrete compressive stress in node region anchoring a one-direction tension tie

$A_{creq} := \dfrac{F_T}{f_{cn}}$ | $A_{creq} = 98 \cdot in^2$ | Required effective area of concrete

$b_{req} := \dfrac{A_{creq}}{h_a}$ | $b_{req} = 4.49 \cdot in$ | Required width of concrete strip in which tension tie reinforcement is distributed

$$CHECK3 := \begin{cases} \text{"OK"} & \text{if } b \ge b_{req} \\ \text{"NG"} & \text{otherwise} \end{cases}$$

CHECK3 = "OK"

Crack Control Reinforcement (AASHTO LRFD 5.6.3.6)

$s_{max} := \min\left(12in, \frac{d}{4}\right)$ $s_{max} = 10 \cdot in$ Maximum spacing of crack control reinforcement

Vertical reinforcement:

$A_v := 0.003 \cdot 12in \cdot b$ $A_v = 0.86 \cdot in^2$ Total area of vertical crack control reinforcement required per foot

Try #9 @ 18" max. (2 legs):

$A_{v\_prov} := 2 \cdot 1.00in^2 \cdot \left(\frac{12in}{18in}\right)$ $A_{v\_prov} = 1.33 \cdot in^2$ Total area of vertical crack control reinforcement provided per foot

$$CHECK4 := \begin{cases} \text{"OK"} & \text{if } A_{v\_prov} \ge A_v \\ \text{"NG"} & \text{otherwise} \end{cases}$$

$CHECK4 = \text{"OK"}$

Horizontal reinforcement:

$A_h := 0.003 \cdot 12in \cdot b$ $A_h = 0.86 \cdot in^2$ Total area of horizontal crack control reinforcement required per foot

Try #8 @ 10" max. (each face):

$A_{h\_prov} := 2 \cdot 0.79in^2 \cdot \left(\frac{12in}{10in}\right)$ $A_{h\_prov} = 1.90 \cdot in^2$ Total area of horizontal crack control reinforcement provided per foot

$$CHECK5 := \begin{cases} \text{"OK"} & \text{if } A_{h\_prov} \ge A_h \\ \text{"NG"} & \text{otherwise} \end{cases}$$

$CHECK5 = \text{"OK"}$

Spacing of vertical reinforcement exceeds maximum due to PT anchorage locations. However, diaphragm will be continuously supported while casting and in the permanent condition. For temporary condition before diaphragm is grouted at top of pylon base, perform shim plate design to avoid cracking of section.

Shrinkage & Temperature Reinforcement (AASHTO LRFD 5.10.8)

$A_s := \max\left[\frac{(1.3b \cdot h \cdot ksi \cdot in)}{2(b+h) \cdot f_y}, 0.11in^2\right]$ $A_s = 0.17 \cdot in^2$ Minimum area of reinforcement in each direction and in each face per foot

Try #5 @ 12":

$A_{s\_prov} := 0.31in^2$

$$CHECK6 := \begin{cases} \text{"OK"} & \text{if } A_{s\_prov} \ge A_s \\ \text{"NG"} & \text{otherwise} \end{cases}$$

$CHECK6 = \text{"OK"}$

End Diaphragm - Type 1 - General Zone Reinforcement (12k6 Tendon)

Parameters

$f_{sallDT} := 30 \cdot ksi$ — *Allowable mild steel stress for direct tension per FIGG Design Directive No. 26*

$\%_{JACK} := 0.75$ — *Max % GUTS*

$f_{pu} := 270 \cdot ksi$ — *Ultimate PT Stress*

$A_{strand} := 0.217 \cdot in^2$ — *Area of a single strand*

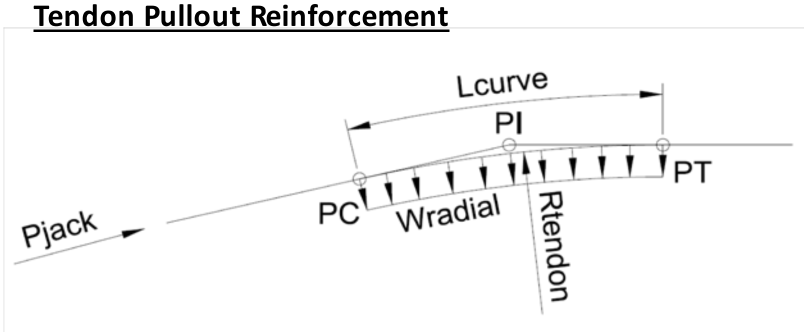
$N_{strand} := 12$ — *Number of single strands*

$R_{TENDON} := 12 \cdot ft$ — *Tendon radius of steel pipe*

$\alpha := 5.59 \cdot deg$ — *Degree of angle change*

$L_{CURVE} := R_{TENDON} \cdot \alpha$ $\qquad L_{CURVE} = 1.17 \cdot ft$

Tendon Pullout Reinforcement



$P_{JACK} := \%_{JACK} \cdot (f_{pu} \cdot A_{strand} \cdot N_{strand})$ $\qquad P_{JACK} = 527 \cdot kip$

$P_{JACK\_HOR} := P_{JACK} \cdot \cos(\alpha)$ $\qquad P_{JACK\_HOR} = 525 \cdot kip$

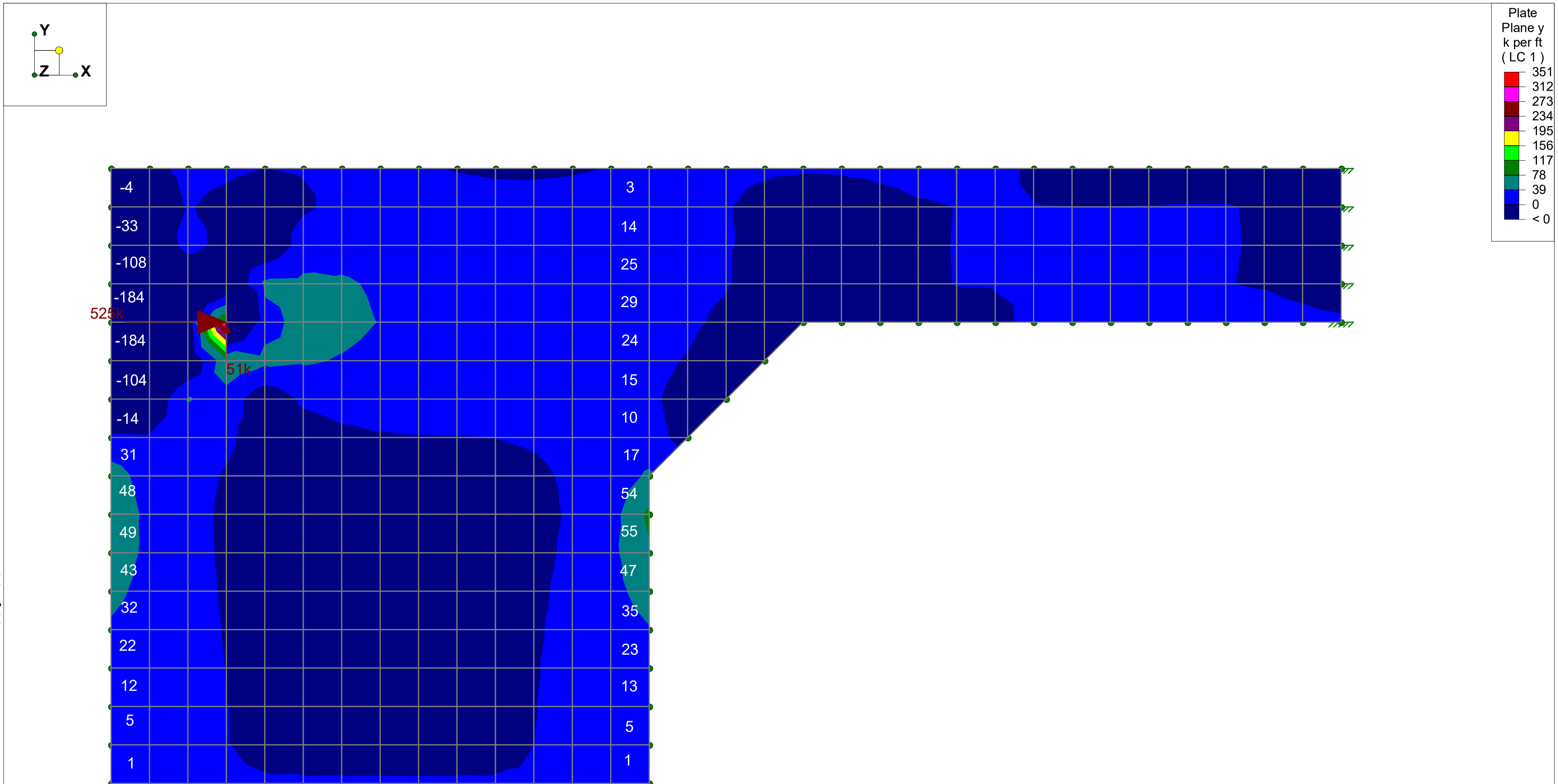
$P_{JACK\_VER} := P_{JACK} \cdot \sin(\alpha)$ $\qquad P_{JACK\_VER} = 51 \cdot kip$

$$w_{RADIAL} := \frac{P_{JACK}}{R_{TENDON}}$$

$$A_{s\_reqd} := \frac{w_{RADIAL} \cdot L_{CURVE}}{f_{sallDT}}$$ $\qquad A_{s\_reqd} = 1.71 \cdot in^2$ — *Steel Required per Tendon*

$A_{s\_prov} := 3 \cdot A_5 \cdot 2$ $\qquad A_{s\_prov} = 1.86 \cdot in^2$ — *Steel Supplied per Tendon (3-#5 hat bars distributed between PT and PC)*

Check1 := if($A_{s\_prov} \geq A_{s\_reqd}$, "OK", "NG") $\qquad$ Check1 = "OK"



T_{ia} = 0.25 ft*(31+48+49+43+32+22+12+5+1 k/ft) = 61 kips
T_{burst} = 0.25 ft*(3+14+25+29+24+15+10+17+54+55+47+35+23+13+5+1 k/ft) = 93 kips

Loads: BLC 1, PT
Results for LC 1, PT (Service)

FIGG	End Diaphragm 1 (12k6 Tendon)	SK - 1
ENH		Oct 3, 2016 at 8:37 AM
2262.03		End Diaphragm 1_3x3_12k6.r3d

End Diaphragm - Type 1 - General Zone Reinforcement (19k6 Tendon)

Parameters

$f_{sallDT} := 30 \cdot ksi$ — *Allowable mild steel stress for direct tension per FIGG Design Directive No. 26*

$\%_{JACK} := 0.75$ — *Max % GUTS*

$f_{pu} := 270 \cdot ksi$ — *Ultimate PT Stress*

$A_{strand} := 0.217 \cdot in^2$ — *Area of a single strand*

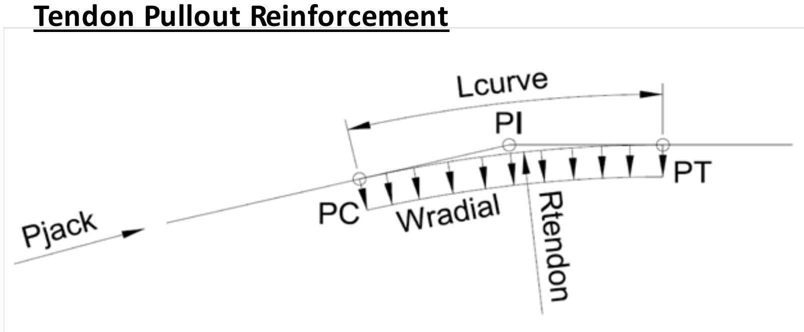
$N_{strand} := 19$ — *Number of single strands*

$R_{TENDON} := 12 \cdot ft$ — *Tendon radius of steel pipe*

$\alpha := 5.59 \cdot deg$ — *Degree of angle change*

$L_{CURVE} := R_{TENDON} \cdot \alpha$ — $L_{CURVE} = 1.17 \cdot ft$

Tendon Pullout Reinforcement



$P_{JACK} := \%_{JACK} \cdot (f_{pu} \cdot A_{strand} \cdot N_{strand})$ — $P_{JACK} = 835 \cdot kip$

$P_{JACK\_HOR} := P_{JACK} \cdot \cos(\alpha)$ — $P_{JACK\_HOR} = 831 \cdot kip$

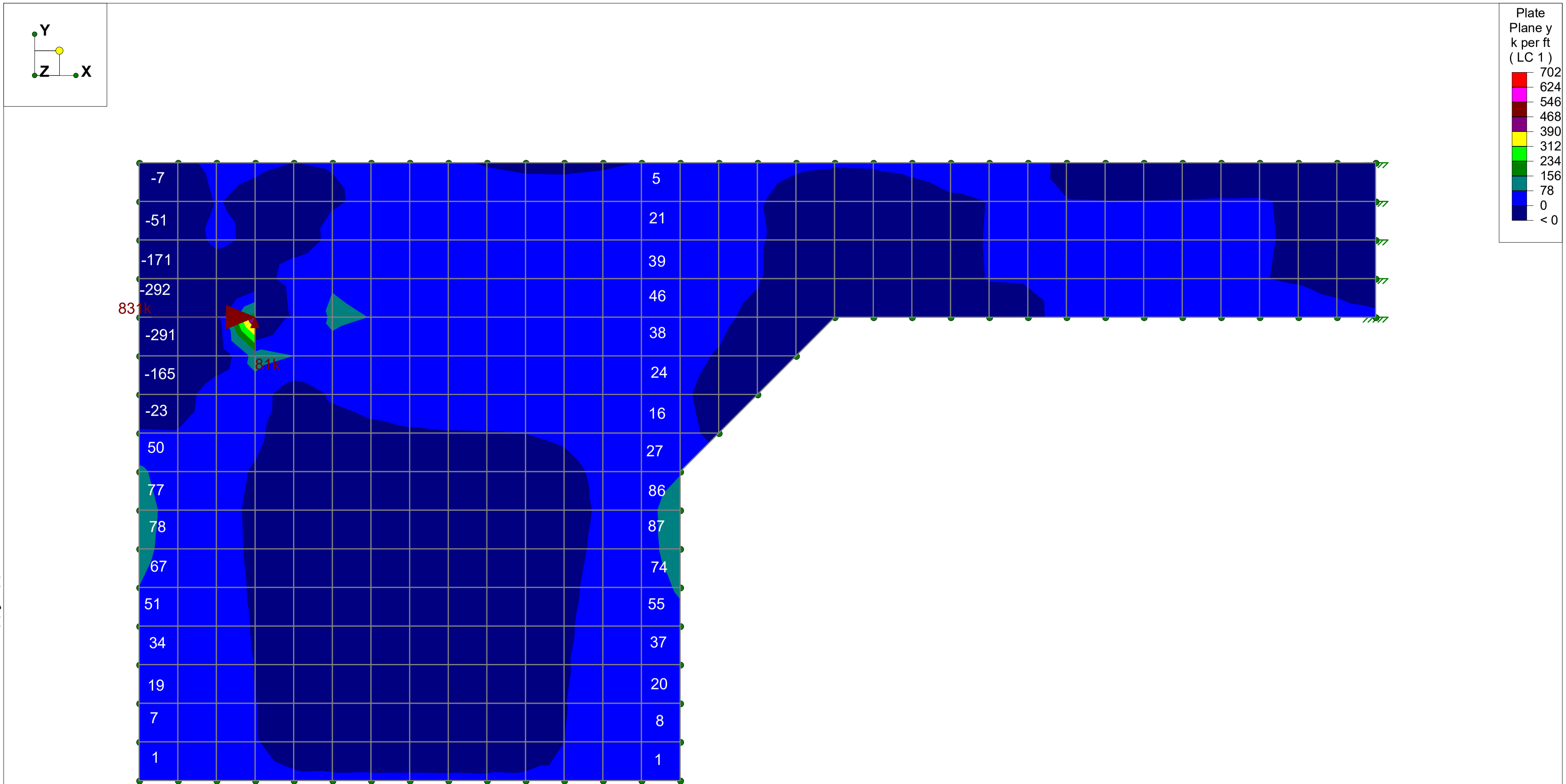
$P_{JACK\_VER} := P_{JACK} \cdot \sin(\alpha)$ — $P_{JACK\_VER} = 81 \cdot kip$

$$w_{RADIAL} := \frac{P_{JACK}}{R_{TENDON}}$$

$$A_{s\_reqd} := \frac{w_{RADIAL} \cdot L_{CURVE}}{f_{sallDT}}$$ $A_{s\_reqd} = 2.72 \cdot in^2$ — *Steel Required per Tendon*

$A_{s\_prov} := 5 \cdot A_5 \cdot 2$ — $A_{s\_prov} = 3.10 \cdot in^2$ — *Steel Supplied per Tendon (5-#5 hat bars distributed between PT and PC)*

$Check1 := if(A_{s\_prov} \geq A_{s\_reqd}, \text{"OK"}, \text{"NG"})$ — $Check1 = \text{"OK"}$



T_{ia} = 0.25 ft*(50+77+78+67+51+34+19+7+1 k/ft) = 96 kips

T_{burst} = 0.25 ft*(5+21+39+46+38+24+16+27+86+87+74+55+37+20+8+1) = 146 kips

Loads: BLC 1, PT
Results for LC 1, PT (Service)

FIGG	End Diaphragm 1 (19k6 Tendon)	SK - 1
ENH		Sept 30, 2016 at 4:16 PM
2262.03		End Diaphragm 1_3x3_19k6.r3d

End Diaphragm 1 - General Zone Reinforcement

Parameters

$f_{sallDT} := 30 \cdot ksi$ — *Allowable mild steel stress for direct tension per FIGG Design Directive No. 26*

$f_y := 60ksi$ — *Specified yield strength of reinforcement*

Tie Back Reinforcement (AASHTO LRFD 5.10.9.3.4b)

$T_{ia} := 61kip + 5 \cdot 96kip$ — $T_{ia} = 541 \cdot kip$ — *See refined RISA-3D analysis for calculation of tie-back tension force (service level)*

$A_{st\_reqd} := \dfrac{T_{ia}}{0.6f_y}$ — $A_{st\_reqd} = 15.03 \cdot in^2$ — *Steel Required per Half Diaphragm*

$A_{st\_prov} := 21 \cdot A_9$ — $A_{st\_prov} = 21.00 \cdot in^2$ — *Steel Supplied per Half Diaphragm (21-#9 bars located at anchor face of diaphragm)*

$Check1 := if\left(A_{st\_prov} \geq A_{st\_reqd}, \text{"OK"}, \text{"NG"}\right)$ — $Check1 = \text{"OK"}$

Bursting Reinforcement (AASHTO LRFD 5.10.9.6.3)

By inspection, service load case will govern.

$T_{burst} := 93kip + 5 \cdot 146kip$ — $T_{burst} = 823 \cdot kip$ — *See refined RISA-3D analysis for calculation of tensile force ahead of anchorage device*

$A_{sb\_reqd} := \dfrac{T_{burst}}{f_{sallDT}}$ — $A_{sb\_reqd} = 27.43 \cdot in^2$ — *Steel Required per Half Diaphragm*

$A_{sb\_prov} := 31 \cdot A_9$ — $A_{sb\_prov} = 31.00 \cdot in^2$ — *Steel Supplied per Half Diaphragm (31-#9 bars located at exit face of diaphragm)*

$Check2 := if\left(A_{sb\_prov} \geq A_{sb\_reqd}, \text{"OK"}, \text{"NG"}\right)$ — $Check2 = \text{"OK"}$

End Diaphragm - Type 2 - General Zone Reinforcement (12k6 Tendon)

Parameters

$f_{sallDT} := 30 \cdot ksi$ — *Allowable mild steel stress for direct tension per FIGG Design Directive No. 26*

$\%_{JACK} := 0.75$ — *Max % GUTS*

$f_{pu} := 270 \cdot ksi$ — *Ultimate PT Stress*

$A_{strand} := 0.217 \cdot in^2$ — *Area of a single strand*

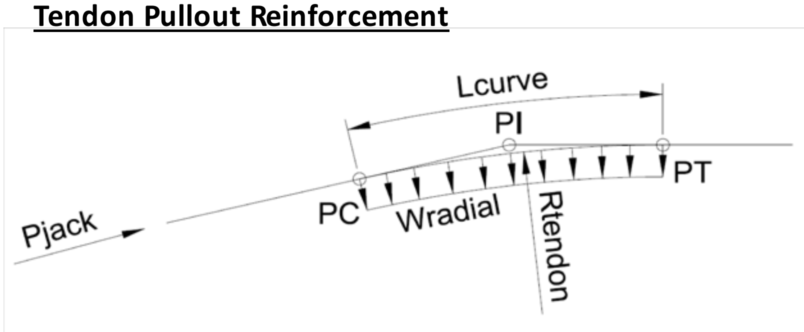
$N_{strand} := 12$ — *Number of single strands*

$R_{TENDON} := 15 \cdot ft$ — *Tendon radius of steel pipe*

$\alpha := 3.17 \cdot deg$ — *Degree of angle change*

$L_{CURVE} := R_{TENDON} \cdot \alpha$ — $L_{CURVE} = 0.83 \cdot ft$

Tendon Pullout Reinforcement



$P_{JACK} := \%_{JACK} \cdot \left(f_{pu} \cdot A_{strand} \cdot N_{strand}\right)$ — $P_{JACK} = 527 \cdot kip$

$P_{JACK\_HOR} := P_{JACK} \cdot \cos(\alpha)$ — $P_{JACK\_HOR} = 527 \cdot kip$

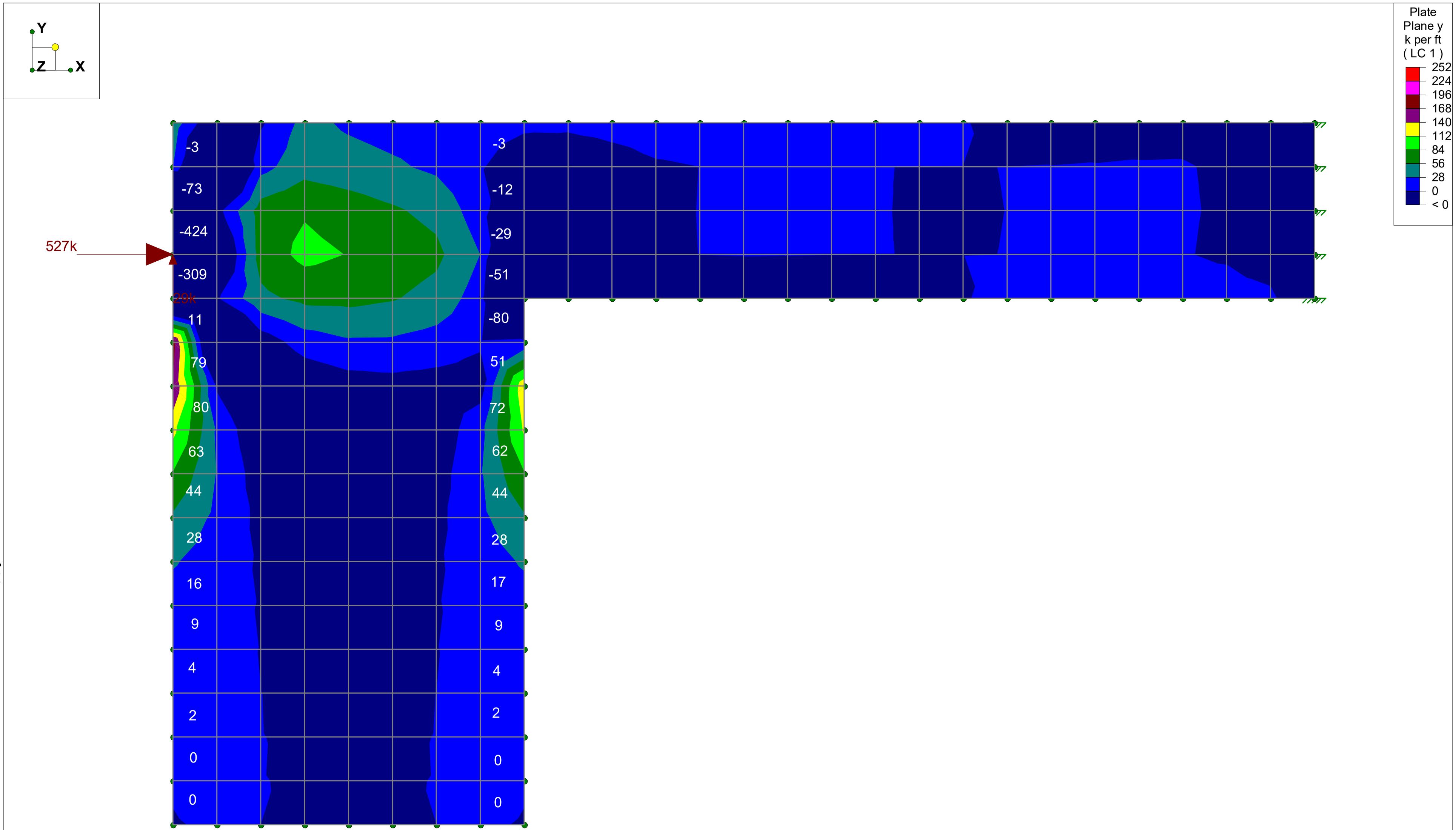
$P_{JACK\_VER} := P_{JACK} \cdot \sin(\alpha)$ — $P_{JACK\_VER} = 29 \cdot kip$

$$w_{RADIAL} := \frac{P_{JACK}}{R_{TENDON}}$$

$$A_{s\_reqd} := \frac{w_{RADIAL} \cdot L_{CURVE}}{f_{sallDT}}$$ $A_{s\_reqd} = 0.97 \cdot in^2$ — *Steel Required per Tendon*

$A_{s\_prov} := 2 \cdot A_5 \cdot 2$ — $A_{s\_prov} = 1.24 \cdot in^2$ — *Steel Supplied per Tendon (2-#5 hat bars distributed between PT and PC)*

$Check1 := if\left(A_{s\_prov} \ge A_{s\_reqd}, \text{"OK"}, \text{"NG"}\right)$ — $Check1 = \text{"OK"}$



T_{ia} = 0.25 ft *(11+79+80+63+44+28+16+9+4+2 k/ft) = 84 kips

T_{burst} = 0.25 ft *(51+72+62+44+28+17+9+4+2 k/ft) = 72 kips

Loads: BLC 1, PT
Results for LC 1, PT (Service)

FIGG		SK - 1
ENH	End Diaphragm 2 (12k6 Tendon)	Sept 30, 2016 at 5:44 PM
2262.03		End Diaphragm 2_3x3_12k6.r3d

End Diaphragm - Type 2 - General Zone Reinforcement (19k6 Tendon - D2)

Parameters

$f_{sallDT} := 30 \cdot ksi$ — *Allowable mild steel stress for direct tension per FIGG Design Directive No. 26*

$\%_{JACK} := 0.75$ — *Max % GUTS*

$f_{pu} := 270 \cdot ksi$ — *Ultimate PT Stress*

$A_{strand} := 0.217 \cdot in^2$ — *Area of a single strand*

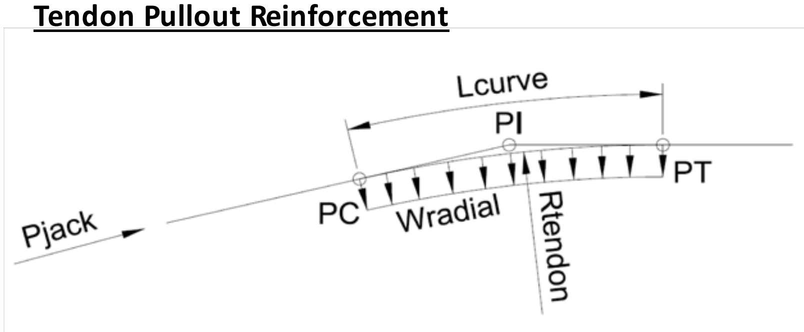
$N_{strand} := 19$ — *Number of single strands*

$R_{TENDON} := 15 \cdot ft$ — *Tendon radius of steel pipe*

$\alpha := 3.17 \cdot deg$ — *Degree of angle change*

$L_{CURVE} := R_{TENDON} \cdot \alpha$ — $L_{CURVE} = 0.83 \cdot ft$

Tendon Pullout Reinforcement



$P_{JACK} := \%_{JACK} \cdot (f_{pu} \cdot A_{strand} \cdot N_{strand})$ — $P_{JACK} = 835 \cdot kip$

$P_{JACK\_HOR} := P_{JACK} \cdot \cos(\alpha)$ — $P_{JACK\_HOR} = 834 \cdot kip$

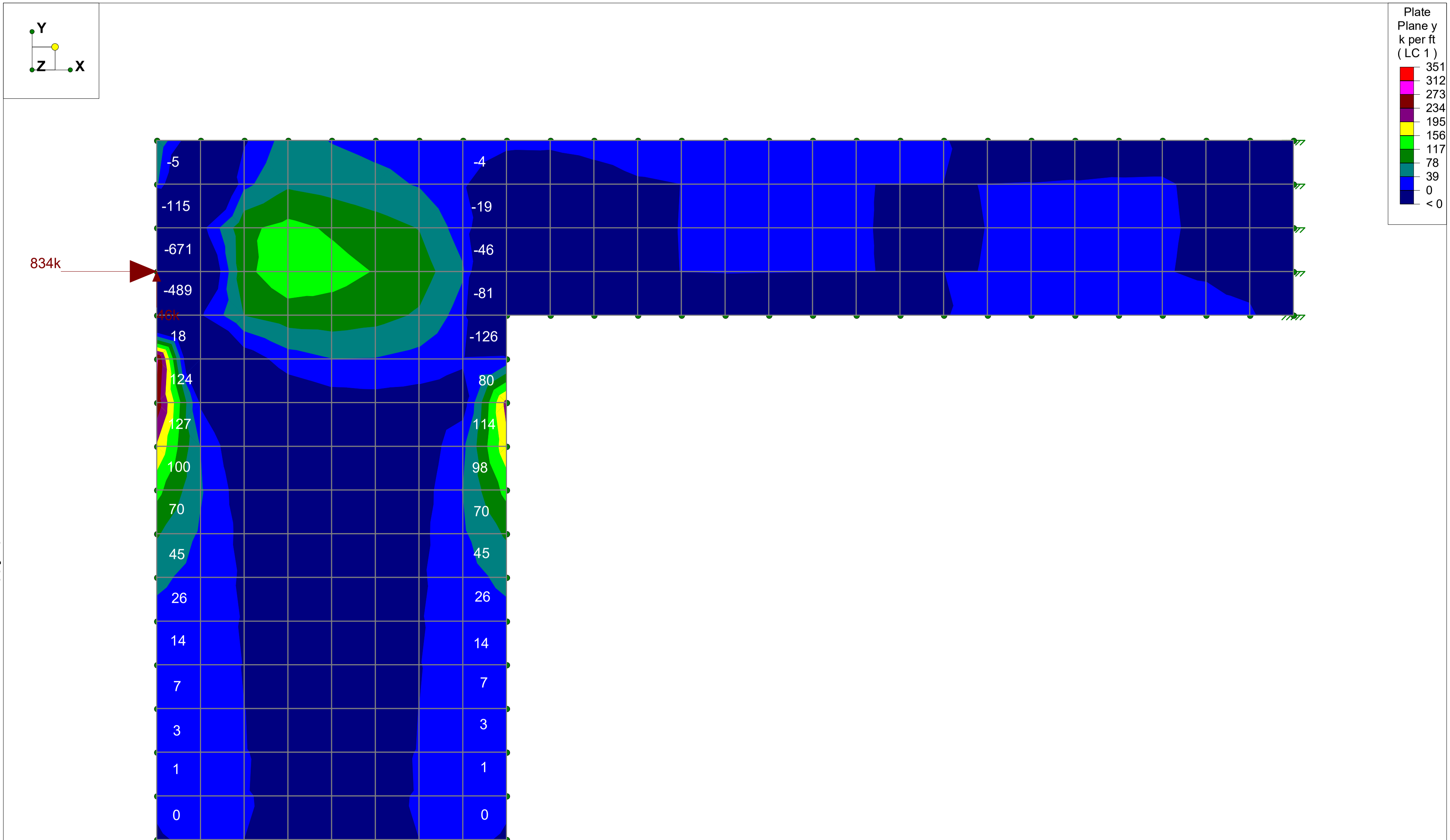
$P_{JACK\_VER} := P_{JACK} \cdot \sin(\alpha)$ — $P_{JACK\_VER} = 46 \cdot kip$

$$w_{RADIAL} := \frac{P_{JACK}}{R_{TENDON}}$$

$$A_{s\_reqd} := \frac{w_{RADIAL} \cdot L_{CURVE}}{f_{sallDT}}$$ $A_{s\_reqd} = 1.54 \cdot in^2$ — *Steel Required per Tendon*

$A_{s\_prov} := 3 \cdot A_5 \cdot 2$ — $A_{s\_prov} = 1.86 \cdot in^2$ — *Steel Supplied per Tendon (3-#5 hat bars distributed between PT and PC)*

$Check1 := if(A_{s\_prov} \geq A_{s\_reqd}, "OK", "NG")$ — $Check1 = "OK"$



T_{ia} = 0.25 ft *(18+124+127+100+70+45+26+14+7+3+1 k/ft) = 134 kips
T_{burst} = 0.25 ft *(80+114+98+70+45+26+14+7+3+1 k/ft) = 115 kips

Loads: BLC 1, PT
Results for LC 1, PT (Service)

FIGG	End Diaphragm 2 (19k6 Tendon)	SK - 1
ENH		Sept 30, 2016 at 5:46 PM
2262.03		End Diaphragm 2_3x3_19k6.r3d

End Diaphragm 2 - General Zone Reinforcement

Parameters

$f_{sallDT} := 30 \cdot ksi$

Allowable mild steel stress for direct tension per FIGG Design Directive No. 26

$f_y := 60ksi$

Specified yield strength of reinforcement

Tie Back Reinforcement (AASHTO LRFD 5.10.9.3.4b)

$T_{ia} := 84kip + 5 \cdot 134kip$ $\qquad T_{ia} = 754 \cdot kip$

See refined RISA-3D analysis for calculation of tie-back tension force (service level)

$A_{st\_reqd} := \dfrac{T_{ia}}{0.6f_y}$ $\qquad A_{st\_reqd} = 20.94 \cdot in^2$

Steel Required per Half Diaphragm

$A_{st\_prov} := 13 \cdot A_9 + 10 \cdot A_8 + A_5$ $\qquad A_{st\_prov} = 21.21 \cdot in^2$

Steel Supplied per Half Diaphragm (13-#9 bars, 10-#8 bars, and 1-#5 bar located at anchor face of diaphragm)

$Check1 := if(A_{st\_prov} \geq A_{st\_reqd}, "OK", "NG")$ $\qquad \boxed{Check1 = "OK"}$

Bursting Reinforcement (AASHTO LRFD 5.10.9.6.3)

By inspection, service load case will govern.

$T_{burst} := 72kip + 5 \cdot 115kip$ $\qquad T_{burst} = 647 \cdot kip$

See refined RISA-3D analysis for calculation of tensile force ahead of anchorage device

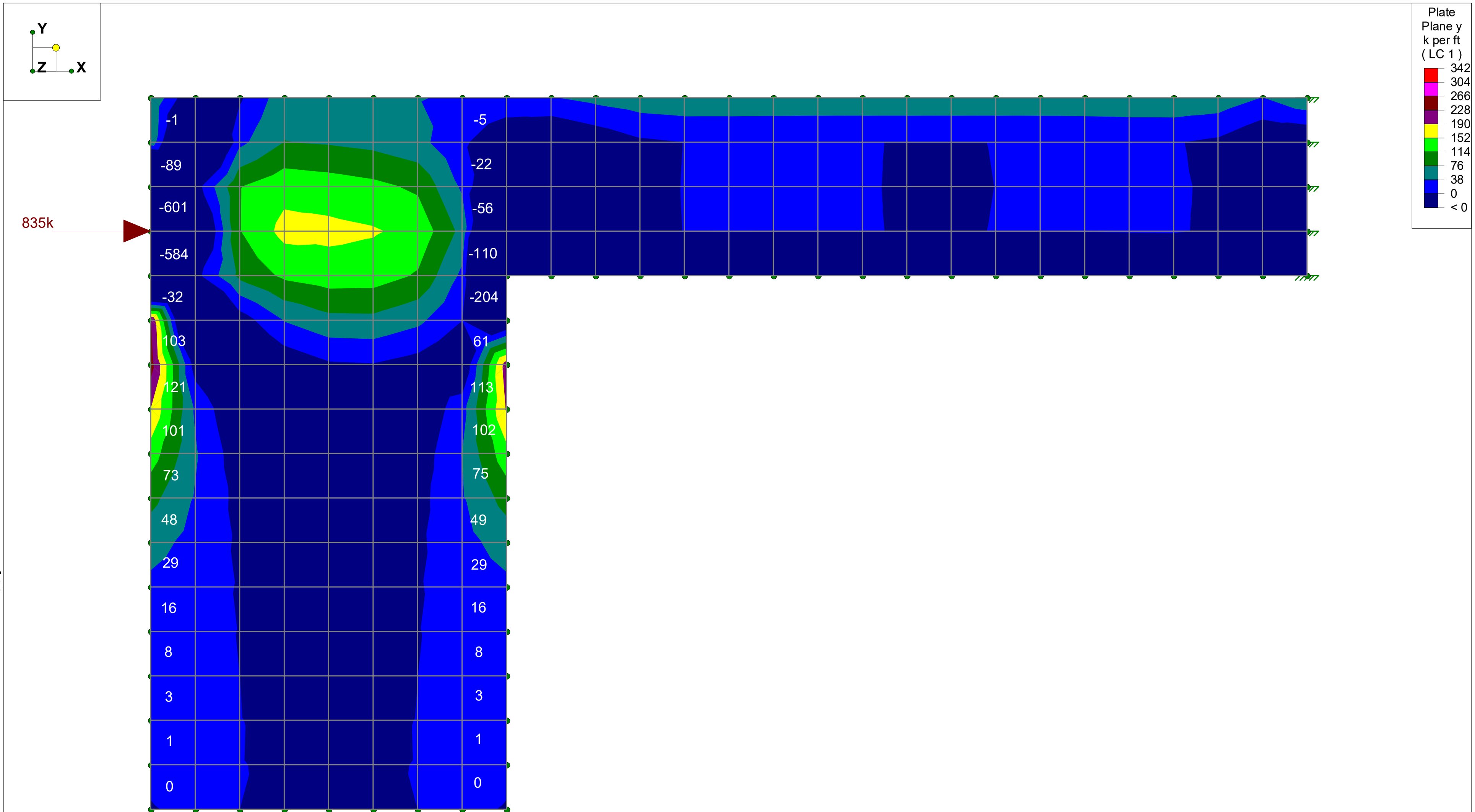
$A_{sb\_reqd} := \dfrac{T_{burst}}{f_{sallDT}}$ $\qquad A_{sb\_reqd} = 21.57 \cdot in^2$

Steel Required per Half Diaphragm

$A_{sb\_prov} := 13 \cdot A_9 + 11A_8$ $\qquad A_{sb\_prov} = 21.69 \cdot in^2$

Steel Supplied per Half Diaphragm (13-#9 bars and 11-#8 bars located at exit face of diaphragm)

$Check2 := if(A_{sb\_prov} \geq A_{sb\_reqd}, "OK", "NG")$ $\qquad \boxed{Check2 = "OK"}$



T_{ia} = 0.25 ft *(103+121+101+73+48+29+16+8+3+1 k/ft) = 126 kips
T_{burst} = 0.25 ft *(61+113+102+75+49+29+16+8+3+1 k/ft) = 114 kips

Loads: BLC 1, PT
Results for LC 1, PT (Service)

FIGG	End Diaphragm 3 (19k6 Tendon)	SK - 1
ENH		Oct 3, 2016 at 9:35 AM
2262.03		End Diaphragm 3_3x3_19k6.r3d

End Diaphragm 3 - General Zone Reinforcement

Parameters

$f_{sallDT} := 30 \cdot ksi$ — *Allowable mild steel stress for direct tension per FIGG Design Directive No. 26*

$f_y := 60ksi$ — *Specified yield strength of reinforcement*

Tie Back Reinforcement (AASHTO LRFD 5.10.9.3.4b)

$T_{ia} := 3 \cdot 126kip$ — $T_{ia} = 378 \cdot kip$ — *See refined RISA-3D analysis for calculation of tie-back tension force (service level)*

$A_{st\_reqd} := \frac{T_{ia}}{0.6f_y}$ — $A_{st\_reqd} = 10.50 \cdot in^2$ — *Steel Required per Half Diaphragm*

$A_{st\_prov} := 8 \cdot A_9 + 6 \cdot A_8$ — $A_{st\_prov} = 12.74 \cdot in^2$ — *Steel Supplied per Half Diaphragm (8-#9 bars and 6-#8 bars located at anchor face of diaphragm)*

$Check1 := if(A_{st\_prov} \geq A_{st\_reqd}, "OK", "NG")$ — $Check1 = "OK"$

Bursting Reinforcement (AASHTO LRFD 5.10.9.6.3)

By inspection, service load case will govern.

$T_{burst} := 3 \cdot 114kip$ — $T_{burst} = 342 \cdot kip$ — *See refined RISA-3D analysis for calculation of tensile force ahead of anchorage device*

$A_{sb\_reqd} := \frac{T_{burst}}{f_{sallDT}}$ — $A_{sb\_reqd} = 11.40 \cdot in^2$ — *Steel Required per Half Diaphragm*

$A_{sb\_prov} := 7 \cdot A_9 + 6A_8$ — $A_{sb\_prov} = 11.74 \cdot in^2$ — *Steel Supplied per Half Diaphragm (7-#9 bars and 6-#8 bars located at exit face of diaphragm)*

$Check2 := if(A_{sb\_prov} \geq A_{sb\_reqd}, "OK", "NG")$ — $Check2 = "OK"$

End Diaphragm - Type 4 - General Zone Reinforcement

Parameters

$f_{sallDT} := 30 \cdot ksi$ — *Allowable mild steel stress for direct tension per FIGG Design Directive No. 26*

$\%_{JACK} := 0.75$ — *Max % GUTS*

$f_{pu} := 270 \cdot ksi$ — *Ultimate PT Stress*

$A_{strand} := 0.217 \cdot in^2$ — *Area of a single strand*

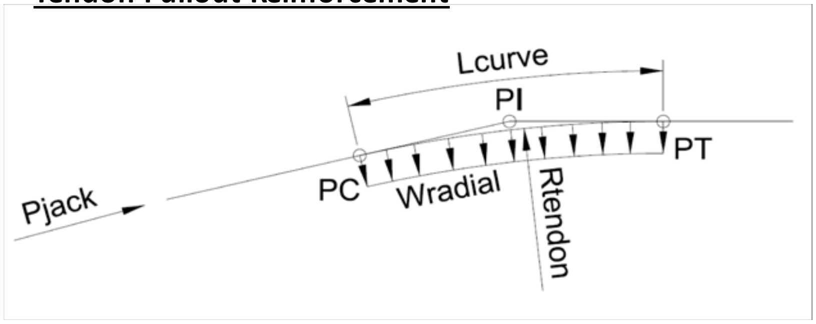
$N_{strand} := 19$ — *Number of single strands*

$R_{TENDON} := 10 \cdot ft$ — *Tendon radius of steel pipe*

$\alpha := 9.53 \cdot deg$ — *Degree of angle change*

$L_{CURVE} := R_{TENDON} \cdot \alpha$ — $L_{CURVE} = 1.66 \cdot ft$

Tendon Pullout Reinforcement



$P_{JACK} := \%_{JACK} \cdot (f_{pu} \cdot A_{strand} \cdot N_{strand})$ — $P_{JACK} = 835 \cdot kip$

$P_{JACK\_HOR} := P_{JACK} \cdot \cos(\alpha)$ — $P_{JACK\_HOR} = 823 \cdot kip$

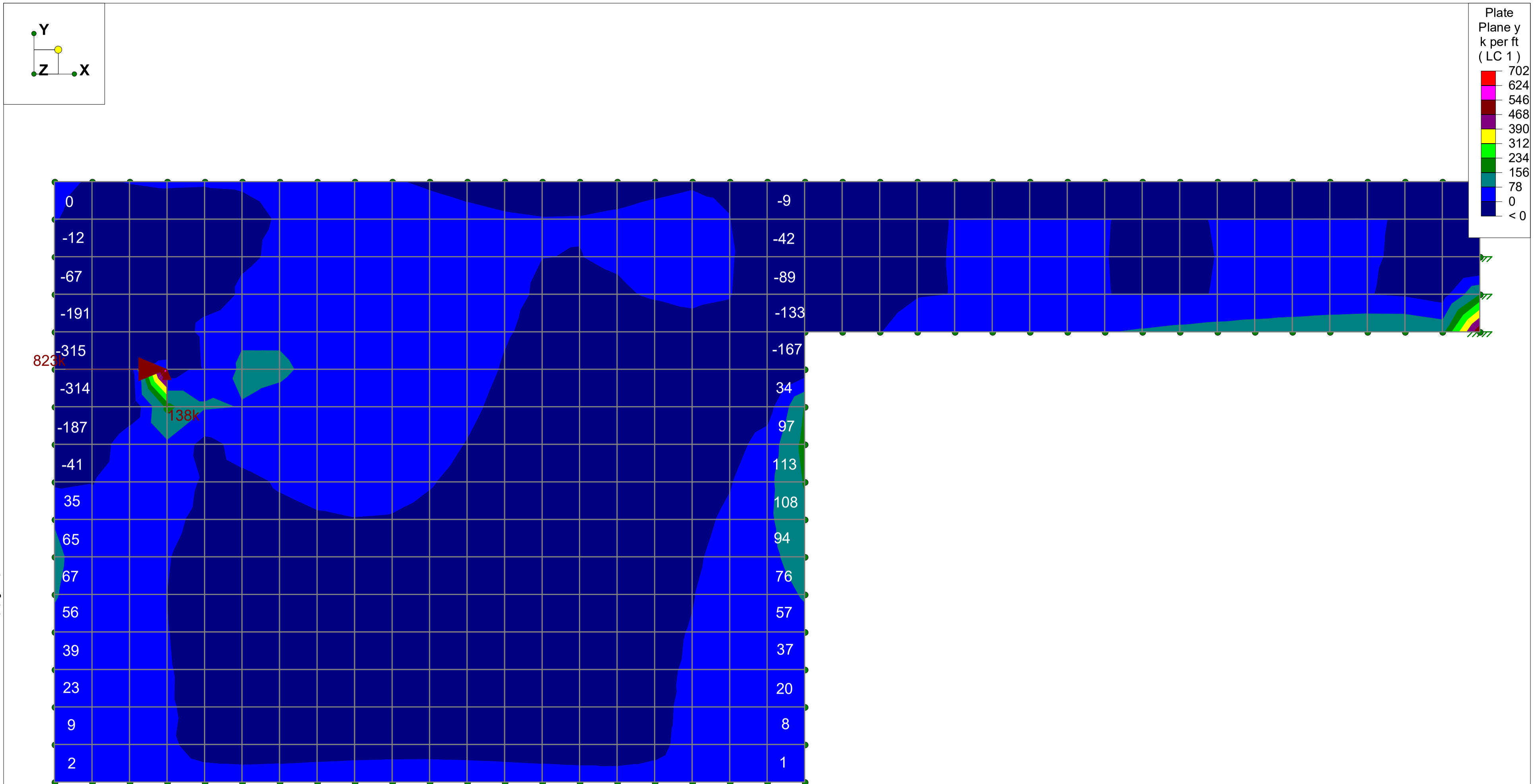
$P_{JACK\_VER} := P_{JACK} \cdot \sin(\alpha)$ — $P_{JACK\_VER} = 138 \cdot kip$

$$w_{RADIAL} := \frac{P_{JACK}}{R_{TENDON}}$$

$$A_{s\_reqd} := \frac{w_{RADIAL} \cdot L_{CURVE}}{f_{sallDT}}$$ $A_{s\_reqd} = 4.63 \cdot in^2$ — *Steel Required per Tendon*

$A_{s\_prov} := 6 \cdot A_6 \cdot 2$ — $A_{s\_prov} = 5.28 \cdot in^2$ — *Steel Supplied per Tendon (6-#6 hat bars distributed between PT and PC)*

$Check1 := if(A_{s\_prov} \geq A_{s\_reqd}, \text{"OK"}, \text{"NG"})$ — $Check1 = \text{"OK"}$



T_{ia} = 0.25 ft *(35+65+67+56+39+23+9+2 k/ft) = 74 kips
T_{burst} = 0.25 ft *(34+97+113+108+94+76+57+37+20+8+1 k/ft) = 161 kips

Loads: BLC 1, PT
Results for LC 1, PT (Service)

FIGG	End Diaphragm 4 (19k6 Tendon)	SK - 1
ENH		Oct 3, 2016 at 9:15 AM
2262.03		End Diaphragm 4_3x3.r3d

End Diaphragm 4 - General Zone Reinforcement

Parameters

$f_{sallDT} := 30 \cdot ksi$ — *Allowable mild steel stress for direct tension per FIGG Design Directive No. 26*

$f_y := 60ksi$ — *Specified yield strength of reinforcement*

Tie Back Reinforcement (AASHTO LRFD 5.10.9.3.4b)

$T_{ia} := 3 \cdot 74kip$ $\quad T_{ia} = 222 \cdot kip$ — *See refined RISA-3D analysis for calculation of tie-back tension force (service level)*

$A_{st\_reqd} := \dfrac{T_{ia}}{0.6f_y}$ $\quad A_{st\_reqd} = 6.17 \cdot in^2$ — *Steel Required per Half Diaphragm*

$A_{st\_prov} := 10 \cdot A_9$ $\quad A_{st\_prov} = 10.00 \cdot in^2$ — *Steel Supplied per Half Diaphragm (10-#9 bars located at anchor face of diaphragm)*

$Check1 := if(A_{st\_prov} \geq A_{st\_reqd}, \text{"OK"}, \text{"NG"})$ $\quad \boxed{Check1 = \text{"OK"}}$

Bursting Reinforcement (AASHTO LRFD 5.10.9.6.3)

By inspection, service load case will govern.

$T_{burst} := 3 \cdot 161kip$ $\quad T_{burst} = 483 \cdot kip$ — *See refined RISA-3D analysis for calculation of tensile force ahead of anchorage device*

$A_{sb\_reqd} := \dfrac{T_{burst}}{f_{sallDT}}$ $\quad A_{sb\_reqd} = 16.10 \cdot in^2$ — *Steel Required per Half Diaphragm*

$A_{sb\_prov} := 18 \cdot A_9$ $\quad A_{sb\_prov} = 18.00 \cdot in^2$ — *Steel Supplied per Half Diaphragm (18-#9 bars located at exit face of diaphragm)*

$Check2 := if(A_{sb\_prov} \geq A_{sb\_reqd}, \text{"OK"}, \text{"NG"})$ $\quad \boxed{Check2 = \text{"OK"}}$

FIGG	Project: FIU PEDESTRIAN BRIDGE	Date: 8/26/16	Page / Of
	Project Number: 2262.03	Designed: ENH	
	Description: TRANSVERSE DESIGN-DECK DIAPHRAGM 4	Checked:	

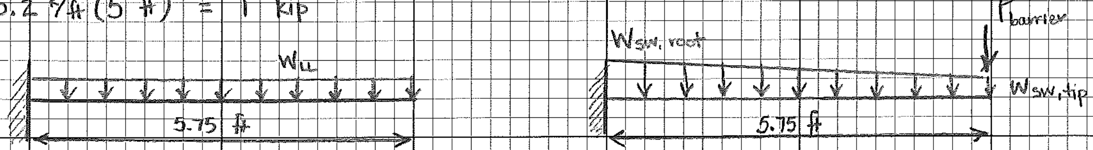
CANTILEVERED WING LOADS

$W_{LL} = 0.090\ ksf(5\ ft) = 0.45\ k/ft$

$W_{sw,tip} = 0.792\ ft(5\ ft)(0.150\ kcf) = 0.59\ k/ft$

$W_{sw,root} = 1.281\ ft(5\ ft)(0.150\ kcf) = 0.96\ k/ft$

$P_{barrier} = 0.2\ k/ft(5\ ft) = 1\ kip$



$M_{LL} = \dfrac{0.45\ k/ft(5.75\ ft)^2}{2} = 7.44\ k{\cdot}ft$

$M_{SW} = \dfrac{0.59\ k/ft(5.75\ ft)^2}{2} + \dfrac{0.5(0.96-0.59\ k/ft)(5.75\ ft)^2}{3} = 11.79\ k{\cdot}ft$

$M_{barrier} = 1\ kip(5.75\ ft) = 5.75\ k{\cdot}ft$

$M_u = 1.25(M_{sw} + M_{barrier}) + 1.75\,M_{LL} = 35\ k{\cdot}ft$

$M_s = 1.00(M_{sw} + M_{barrier}) + 1.00\,M_{LL} = 25\ k{\cdot}ft$

SECTION PROPERTIES

$A = 5\ ft(1.281\ ft) = 6.41\ ft^2$

$S = \frac{1}{6}(5\ ft)(1.281\ ft)^2 = 1.37\ ft^3$

PT EFFECTS

From LARSA transverse model at long term, $P_e = 155^k + 157^k = 312^k$ (two 4K6 tendons)

$e = 0.297\ ft$

$M = P_e\,e = 312^k(0.297\ ft) = 92.66\ k{\cdot}ft$

From LARSA transverse model at EOC, $P_e = 156^k + 158^k = 314^k$

$M = 314^k(0.297\ ft) = 93.26\ k{\cdot}ft$

From LARSA transverse model at Stress PT stage, $P_e = 158^k + 160^k = 318^k$

$M = 318^k(0.297\ ft) = 94.45\ k{\cdot}ft$

See Excel spreadsheet for calculation of stresses at root of cantilever.

CREATING BRIDGES AS ART®

	Project	Date
FIGG	FIU Pedestrian Bridge	10/03/16
	Project Number	Designed
	2262.03	ENH
	Description	Checked
	Deck Diaphragm Type IV	

f'c (28 days) [psi]	8500

	SECTION PROPERTIES		
	STRESS*	EOC	LT
AREA [FT^2]	6.41	6.41	6.41
SECTION MODULUS [FT^3]	1.37	1.37	1.37
TENDON ECCENTRICITY [FT]	0.30	0.30	0.30

	STRESS*	EOC	LT
DL MOMENT [k*ft]	-11.79	-17.54	-17.54
PT MOMENT [k*ft]	94.45	93.26	92.66
PT FORCE [kips]	-318	-314	-312
LL MOMENT [k*ft]	0.00	-7.44	-7.44

	STRESSES AT ROOT OF CANTILEVER [KSF]		
	CAST	EOC	LT
DL, TOP	8.6	12.8	12.8
DL, BOTTOM	-8.6	-12.8	-12.8
PT, TOP	-118.5	-117.1	-116.3
PT, BOTTOM	19.3	19.1	19.0
LL, TOP	0.0	5.4	5.4
LL, BOTTOM	0.0	-5.4	-5.4
TOTAL, TOP	-109.9	-98.8	-98.1
TOTAL, BOTTOM	10.7	0.9	0.7

MAX TENSION [ksf]	10.7	0.9	0.7
ALLOWABLE [ksf]	39.8	39.8	39.8
CHECK	OK	OK	OK

MAX COMPRESSION [ksf]	-109.9	-98.8	-98.1
ALLOWABLE [ksf]	-550.8	-550.8	-550.8
CHECK	OK	OK	OK

* Transverse tendons have been stressed and short-term losses have occurred.

Project FIU PEDESTRIAN BRIDGE	Date 8/26/16	Page / Of
Project Number 2262.03	Designed ENH	
Description TRANSVERSE DESIGN – DECK DIAPHRAGM 4	Checked	

MILD REINFORCEMENT @ TOP OF SECTION

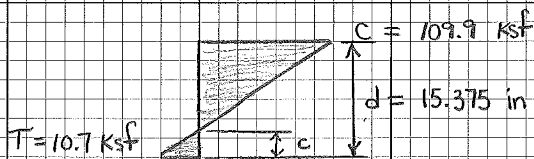
Extreme fiber is in compression per Stress Check. Therefore, provide shrinkage and temperature reinforcement per AASHTO LRFD 5.10.8.

$$A_s = \frac{1.30\,b\,h}{2(b+h)\,f_y} = \frac{1.30(60\text{ in})(9.5\text{ in})}{2(60\text{ in} + 9.5\text{ in})(60\text{ ksi})} = 0.09\ \text{in}^2/\text{ft} < 0.11\ \text{in}^2/\text{ft} \longrightarrow 0.11\ \text{in}^2/\text{ft}\ \text{governs}$$

Use #4 @ 12". $A_{s,prov} = 0.20\ \text{in}^2/\text{ft} > 0.11\ \text{in}^2/\text{ft}$ OK

MILD REINFORCEMENT @ BOTTOM OF SECTION

After tendons are stressed and short term losses have occurred, extreme fiber is in tension. Provide mild reinforcement for this tensile force.



From similar triangles, $\dfrac{c}{10.7\text{ ksf}} = \dfrac{15.375\text{ in} - c}{109.9\text{ ksf}}$

$$c = (15.375 - c)\,0.097$$
$$c = 1.497 - 0.097c$$
$$c = \frac{1.497}{1.097} = 1.36\text{ in}$$

$$T = \tfrac{1}{2}(10.7\text{ ksf})(5\text{ ft})(0.11\text{ ft}) = 2.95\text{ Kips}$$

$$A_s = \frac{T}{30\text{ ksi}} = \frac{2.95\text{ Kips}}{30\text{ ksi}} = 0.10\text{ in}^2$$

$$A_{s,prov} = 5(0.44\text{ in}^2) = 2.20\text{ in}^2 > 0.10\text{ in}^2 \quad \text{OK}$$

FIGG	Project: FIU PEDESTRIAN BRIDGE	Date: 8/29/16	Page ___ Of ___
	Project Number: 2262.03	Designed: ENH	
	Description: TRANSVERSE DESIGN - DECK DIAPHRAGM 1	Checked:	

CANTILEVERED WING LOADS

Deck diaphragm 1 is 3.5 ft wide and deck diaphragm 4 is 5 ft wide. Therefore, factor loads previously calculated for deck diaphragm 4.

$$M_{LL} = \frac{7.44 \text{ k·ft} (3.5 \text{ ft})}{5 \text{ ft}} = 5.21 \text{ k·ft}$$

$$M_{sw} = \frac{11.79 \text{ k·ft} (3.5 \text{ ft})}{5 \text{ ft}} = 8.25 \text{ k·ft}$$

$$M_{barrier} = \frac{5.75 \text{ k·ft} (3.5 \text{ ft})}{5 \text{ ft}} = 4.03 \text{ k·ft}$$

SECTION PROPERTIES

$$A = 3.5 \text{ ft} (1.281 \text{ ft}) = 4.48 \text{ ft}^2$$

$$S = \tfrac{1}{6}(3.5 \text{ ft})(1.281 \text{ ft})^2 = 0.96 \text{ ft}^3$$

PT EFFECTS

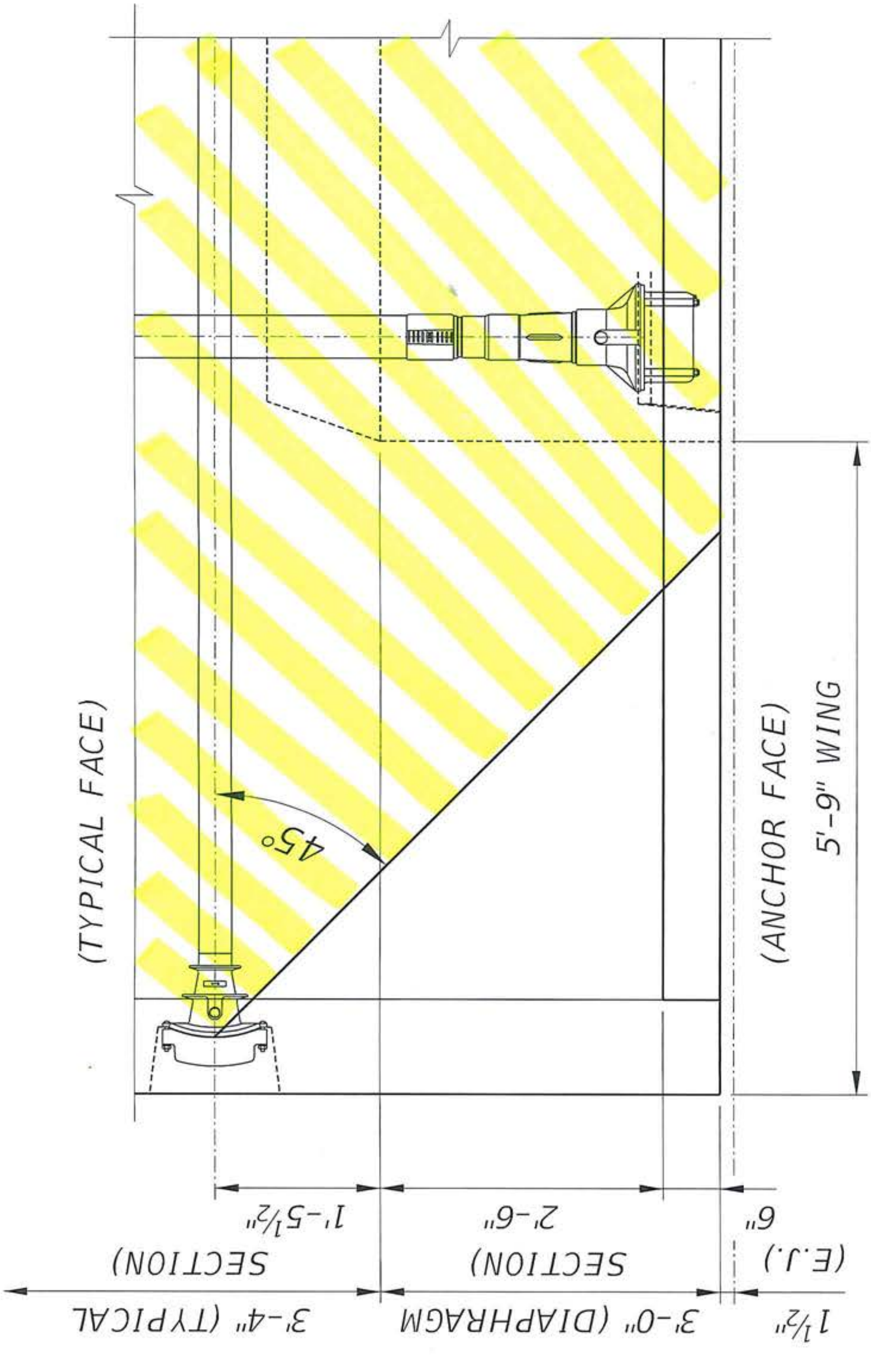
One transverse tendon (4K6). See attached sketch. Transverse model for deck diaphragm 4 was setup for two 4K6 tendons. Factor tendon forces accordingly.

LT: $P_e = \frac{312^k}{2} = 156^k$ $\quad M = 156^k (0.297 \text{ ft}) = 46.33 \text{ k·ft}$

Ecc: $P_e = \frac{314^k}{2} = 157^k$ $\quad M = 157^k (0.297 \text{ ft}) = 46.63 \text{ k·ft}$

Stress PT Stage: $P_e = \frac{318^k}{2} = 159^k$ $\quad M = 159^k (0.297 \text{ ft}) = 47.22 \text{ k·ft}$

See Excel spreadsheet for calculation of stresses at root of cantilever.



END DIAPHRAGM TYPE I

	Project	Date
FIGG	FIU Pedestrian Bridge	10/03/16
	Project Number	Designed
	2262.03	ENH
	Description	Checked
	Deck Diaphragm Type I	

f'c (28 days) [psi]	8500

	SECTION PROPERTIES		
	STRESS*	EOC	LT
AREA [FT^2]	4.48	4.48	4.48
SECTION MODULUS [FT^3]	0.96	0.96	0.96
TENDON ECCENTRICITY [FT]	0.30	0.30	0.30

	STRESS*	EOC	LT
DL MOMENT [k*ft]	-8.25	-12.28	-12.28
PT MOMENT [k*ft]	47.22	46.63	46.33
PT FORCE [kips]	-159	-157	-156
LL MOMENT [k*ft]	0.00	-5.21	-5.21

	STRESSES AT ROOT OF CANTILEVER [KSF]		
	CAST	EOC	LT
DL, TOP	8.6	12.8	12.8
DL, BOTTOM	-8.6	-12.8	-12.8
PT, TOP	-84.7	-83.6	-83.1
PT, BOTTOM	13.7	13.5	13.4
LL, TOP	0.0	5.4	5.4
LL, BOTTOM	0.0	-5.4	-5.4
TOTAL, TOP	-76.1	-65.4	-64.9
TOTAL, BOTTOM	5.1	-4.7	-4.8

MAX TENSION [ksf]	5.1	-4.7	-4.8
ALLOWABLE [ksf]	39.8	39.8	39.8
CHECK	OK	OK	OK

MAX COMPRESSION [ksf]	-76.1	-65.4	-64.9
ALLOWABLE [ksf]	-550.8	-550.8	-550.8
CHECK	OK	OK	OK

* Transverse tendons have been stressed and short-term losses have occurred.

MILD REINFORCEMENT @ TOP OF SECTION

Conservatively, assume post-tensioning is not present and design for DL + LL. See Mathcad sheet for Strength check.

Extreme fiber is in compression per Stress check considering post-tensioning effects. Therefore, strength requirements govern design.

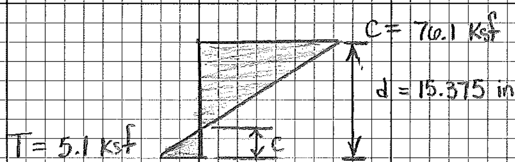
Check shrinkage and temperature reinforcement per AASHTO LRFD 5.10.8.

$$A_s = \frac{1.30(42 \text{ in})(9.5 \text{ in})}{2(42 \text{ in} + 9.5 \text{ in})(60 \text{ ksi})} = 0.08 \ \frac{\text{in}^2}{\text{ft}} < 0.11 \ \frac{\text{in}^2}{\text{ft}} \rightarrow 0.11 \ \frac{\text{in}^2}{\text{ft}} \text{ governs}$$

$$A_{s,prov} = \frac{0.80 \text{ in}^2}{3.5 \text{ ft}} = 0.23 \ \frac{\text{in}^2}{\text{ft}} > 0.11 \ \frac{\text{in}^2}{\text{ft}} \quad \text{OK}$$

MILD REINFORCEMENT @ BOTTOM OF SECTION

After tendons are stressed and short term losses have occurred, extreme fiber is in tension. Provide mild reinforcement for this tensile force.



For similar triangles, $\frac{c}{5.1 \text{ ksf}} = \frac{15.375 \text{ in} - c}{76.1 \text{ ksf}}$

$$c = (15.375 - c)\,0.067$$

$$c = 1.030 - 0.067c$$

$$c = \frac{1.030}{1.067} = 0.97 \text{ in}$$

$$T = \tfrac{1}{2}(5.1 \text{ ksf})(3.5 \text{ ft})(0.08 \text{ ft}) = 0.71 \text{ kips}$$

$$A_s = \frac{0.71 \text{ kips}}{30 \text{ ksi}} = 0.02 \text{ in}^2$$

$$A_{s,prov} = 4(0.31 \text{ in}^2) = 1.24 \text{ in}^2 > 0.02 \text{ in}^2 \quad \text{OK}$$

END DIAPHRAGM TYPE I
ULTIMATE MOMENT - CHECK NEGATIVE MOMENT AT ROOT OF CANTILEVER

MATERIAL PROPERTIES

$f_c := 8.5 \cdot ksi$

$f_y := 60 \cdot ksi$

$A'_s := 1 \cdot in^2$

SECTION PROPERTIES

$k := 1000 \cdot lbf$

$h := 15.375 \cdot in$ *Height of section*

$b := 42 \cdot in$ *Width of section*

$d_{bar} := 0.50 \cdot in$ *Bar diameter (#4)*

$cov := 2.25 \cdot in$ *Clear cover*

$c := cov + 0.5 \cdot d_{bar} = 2.5 \cdot in$ *Cover to center of bar*

$S_x := \frac{b \cdot h^2}{6} = 0.96 \cdot ft^3$ *Section modulus*

BENDING MOMENTS

$M_{DC} := -12.28 \cdot k \cdot ft$ *Dead Load Moment*

$M_{LL} := -5.21 \cdot k \cdot ft$ *Live Load Moment*

$M_{PT} := 0 \cdot k \cdot ft$ *Assume no PT Moment*

$F_{PRIM} := 0 \cdot k$ (enter positive)

$M_{PRIM} := 0 \cdot k \cdot ft$ (enter positive)

$M_{u1} := 1.25 \cdot M_{DC} + 1.75 \cdot M_{LL} + M_{PT}$ $M_{u1} = -24 \cdot k \cdot ft$ *Ultimate Design Moment (Strength I)*

$M_{u2} := 0.9 \cdot M_{DC} + 1.75 \cdot M_{LL} + M_{PT}$ $M_{u2} = -20 \cdot k \cdot ft$

$M_u := \max(|M_{u1}|, |M_{u2}|)$ $\boxed{M_u = 24 \cdot k \cdot ft}$

MINIMUM REINFORCEMENT CHECK (AASHTO LRFD 5.7.3.3.2)

$f_r := 0.24 \cdot \sqrt{\frac{f_c}{ksi}} \cdot ksi$ $\quad f_r = 0.700 \cdot ksi$ *Modulus of Rupture*

$f_{cpe} := \frac{F_{PRIM}}{h \cdot b} + \frac{M_{PRIM}}{S_x}$ $\quad f_{cpe} = 0.000 \cdot ksi$ *Compressive stress from PT*

$\gamma_1 := 1.6$ *Flexural cracking variability factor*

$\gamma_2 := 1.1$ *Prestress variability factor*

$\gamma_3 := 0.67$ *Yield/Ultimate ratio factor*

$M_{u3} := 1.33 \cdot M_u$ $\quad M_{u3} = 33 \cdot k \cdot ft$

$M_{u4} := \gamma_3 \cdot (\gamma_1 \cdot f_r + \gamma_2 \cdot f_{cpe}) \cdot S_x$ $\quad M_{u4} = 103 \cdot k \cdot ft$

$M_{u.min} := \max(\min(|M_{u3}|, |M_{u4}|), |M_u|)$ $\quad \boxed{M_{u.min} = 33 \cdot k \cdot ft}$

CHECK1 := | "OK" if $|M_u| \geq |M_{u.min}|$
| "DESIGN FOR MIN. REQUIREMENT" otherwise

CHECK1 = "DESIGN FOR MIN. REQUIREMENT"

TRANSVERSE MILD REINFORCEMENT DESIGN (TOP OF SECTION)

$\phi := 0.9$

$d := h - c = 12.88 \cdot in$

$a(A_s) := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$

$\phi M_n(A_s) := \phi \cdot A_s \cdot f_y \cdot \left(d - \frac{a(A_s)}{2}\right)$

$A_s := \mathrm{root}(M_{u.min} - \phi M_n(A'_s), A'_s, 0.0 \cdot in^2, 10 \cdot in^2)$ $\quad \boxed{A_s = 0.56 \cdot in^2}$

Try 4-#4:

$A_{s\_prov} := 4 \cdot 0.20 in^2 = 0.80 \cdot in^2$

CHECK2 := | "OK" if $A_{s\_prov} \geq A_s$
| "NG" otherwise

CHECK2 = "OK"

FIGG	Project: FIU PEDESTRIAN BRIDGE	Date: 8/29/16	Page / Of
	Project Number: 2262.03	Designed: ENH	
	Description: TRANSVERSE DESIGN – DECK DIAPHRAGM 2+3	Checked:	

CANTILEVER WING LOADS

Deck diaphragm 2 is 3 ft wide and deck diaphragm 4 is 5 ft wide. Therefore, factor loads previously calculated for deck diaphragm 4.

$$M_{LL} = \frac{7.44\ k\cdot ft\,(3\ ft)}{5\ ft} = 4.46\ k\cdot ft$$

$$M_{SW} = \frac{11.79\ k\cdot ft\,(3\ ft)}{5\ ft} = 7.07\ k\cdot ft$$

$$M_{barrier} = \frac{5.75\ k\cdot ft\,(3\ ft)}{5\ ft} = 3.45\ k\cdot ft$$

SECTION PROPERTIES

$$A = 3\ ft\,(1.281\ ft) = 3.84\ ft^2$$

$$S = \tfrac{1}{6}(3\ ft)(1.281\ ft)^2 = 0.82\ ft^3$$

PT EFFECTS

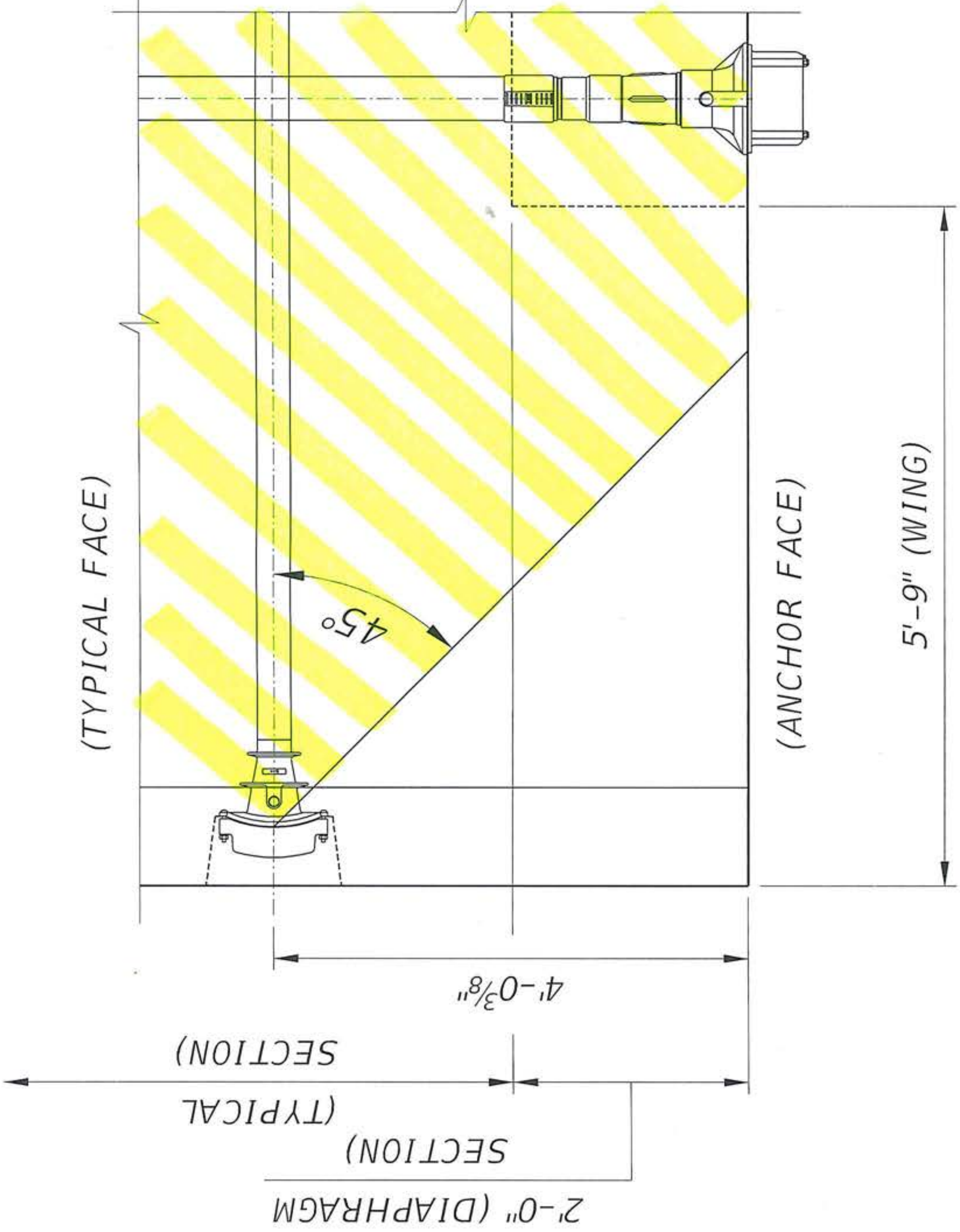
One transverse tendon (4k6). See attached sketch. Transverse model for deck diaphragm 4 was setup for two 4k6 tendons. Factor tendon forces accordingly.

LT: $P_e = \frac{312^k}{2} = 156^k$ $\quad M = 156^k(0.297\ ft) = 46.33\ k\cdot ft$

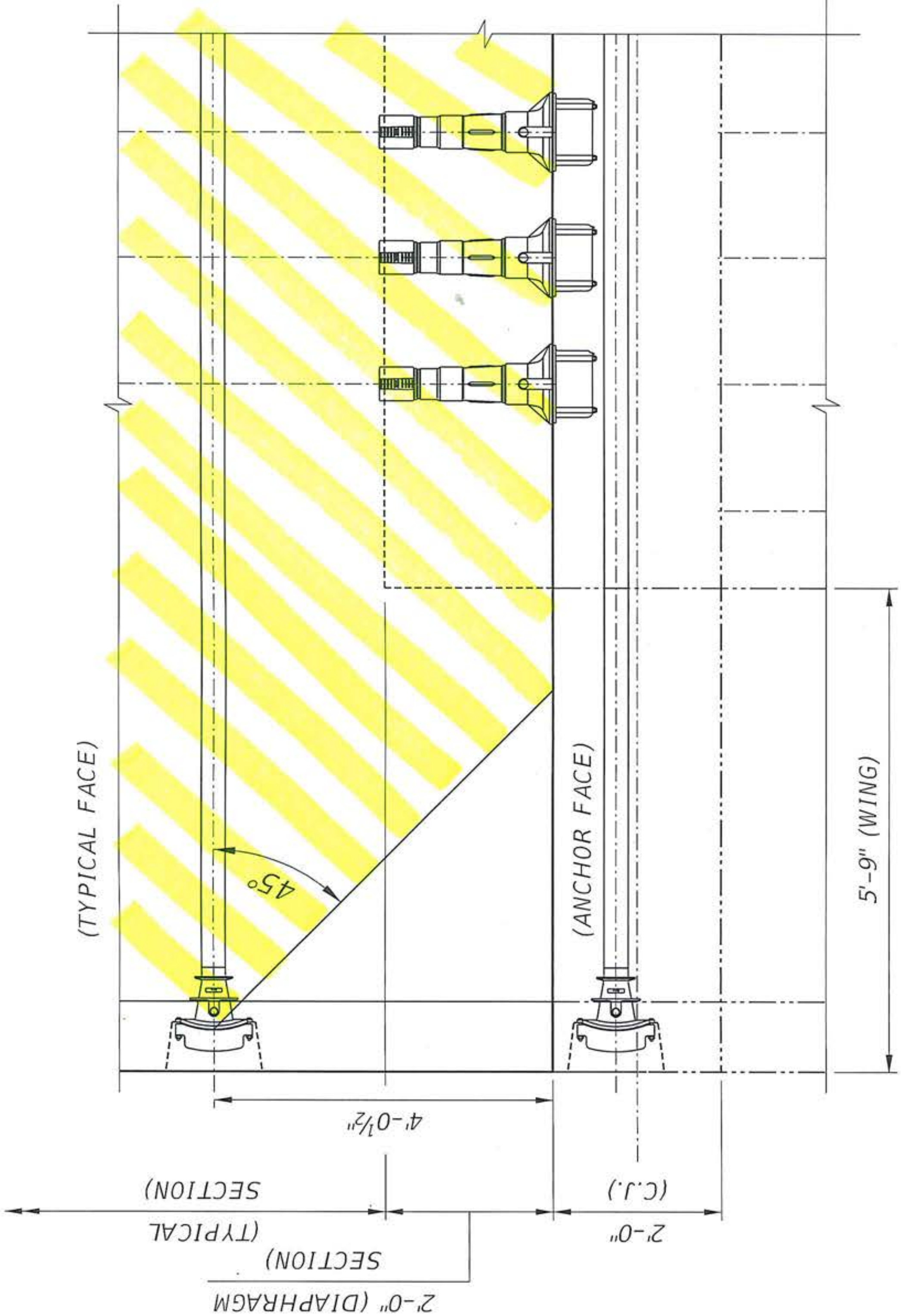
EOC: $P_e = \frac{314^k}{2} = 157^k$ $\quad M = 157^k(0.297\ ft) = 46.63\ k\cdot ft$

Stress PT Stage: $P_e = \frac{318^k}{2} = 159^k$ $\quad M = 159^k(0.297\ ft) = 47.22\ k\cdot ft$

See Excel spreadsheet for calculation of stresses at root of cantilever.



END DIAPHRAGM TYPE II



END DIAPHRAGM TYPE III

	Project	Date
FIGG	FIU Pedestrian Bridge	10/03/16
	Project Number	Designed
	2262.03	ENH
	Description	Checked
	Deck Diaphragm Type 2 & 3	

f'c (28 days) [psi]	8500

	SECTION PROPERTIES		
	STRESS*	EOC	LT
AREA [FT^2]	3.84	3.84	3.84
SECTION MODULUS [FT^3]	0.82	0.82	0.82
TENDON ECCENTRICITY [FT]	0.30	0.30	0.30

	STRESS*	EOC	LT
DL MOMENT [k*ft]	-7.07	-10.52	-10.52
PT MOMENT [k*ft]	47.22	46.63	46.33
PT FORCE [kips]	-159	-157	-156
LL MOMENT [k*ft]	0.00	-4.46	-4.46

	STRESSES AT ROOT OF CANTILEVER [KSF]		
	CAST	EOC	LT
DL, TOP	8.6	12.8	12.8
DL, BOTTOM	-8.6	-12.8	-12.8
PT, TOP	-99.0	-97.8	-97.1
PT, BOTTOM	16.2	16.0	15.9
LL, TOP	0.0	5.4	5.4
LL, BOTTOM	0.0	-5.4	-5.4
TOTAL, TOP	-90.4	-79.5	-78.9
TOTAL, BOTTOM	7.6	-2.3	-2.4

MAX TENSION [ksf]	7.6	-2.3	-2.4
ALLOWABLE [ksf]	39.8	39.8	39.8
CHECK	OK	OK	OK

MAX COMPRESSION [ksf]	-90.4	-79.5	-78.9
ALLOWABLE [ksf]	-550.8	-550.8	-550.8
CHECK	OK	OK	OK

* Transverse tendons have been stressed and short-term losses have occurred.

Project	Date	Page
FIU PEDESTRIAN BRIDGE	8/29/16	/ Of /
Project Number: 2262.03	Designed: ENH	
Description: TRANSVERSE DESIGN - DECK DIAPHRAGM 2+3	Checked	

FIGG

MILD REINFORCEMENT @ TOP OF SECTION

Conservatively, assume post-tensioning is not present and design for DL+LL. See Mathcad sheet for Strength check.

Extreme fiber is in compression per stress check considering post-tensioning effects. Therefore, strength requirements govern design.

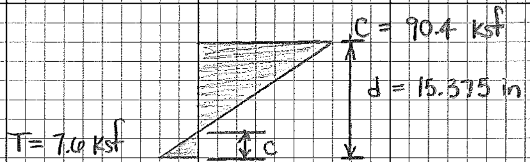
Check shrinkage and temperature reinforcement per AASHTO LRFD 5.10.8.

$$A_s = \frac{1.30\,(36\text{ in})(9.5\text{ in})}{2(36\text{ in} + 9.5\text{ in})(60\text{ ksi})} = 0.08\ \frac{\text{in}^2}{\text{ft}} < 0.11\ \frac{\text{in}^2}{\text{ft}} \rightarrow 0.11\ \frac{\text{in}^2}{\text{ft}}\ \text{governs}$$

$$A_{s,prov} = \frac{3(0.20\text{ in}^2)}{3\text{ ft}} = 0.20\ \frac{\text{in}^2}{\text{ft}} > 0.11\ \frac{\text{in}^2}{\text{ft}}\quad \text{OK}$$

MILD REINFORCEMENT @ BOTTOM OF SECTION

After tendons are stressed and short term losses have occurred, extreme fiber is in tension. Provide mild reinforcement for this tensile force.



For similar triangles, $\dfrac{c}{7.6\text{ ksf}} = \dfrac{15.375\text{ in} - c}{90.4\text{ ksf}}$

$$c = (15.375 - c)\,0.084$$
$$c = 1.293 - 0.084c$$
$$c = \frac{1.293}{1.084} = 1.19\text{ in}$$

$$T = \tfrac{1}{2}(7.6\text{ ksf})(3\text{ ft})(0.10\text{ ft}) = 1.13\text{ Kips}$$
$$A_s = \frac{1.13\text{ Kips}}{30\text{ ksi}} = 0.04\text{ in}^2$$

$$A_{s,prov} = 4(0.31\text{ in}^2) = 1.24\text{ in}^2 > 0.04\text{ in}^2\quad \text{OK}$$

END DIAPHRAGM TYPE II & III
ULTIMATE MOMENT - CHECK NEGATIVE MOMENT AT ROOT OF CANTILEVER

MATERIAL PROPERTIES

$f_c := 8.5 \cdot ksi$

$f_y := 60 \cdot ksi$

$A'_s := 1 \cdot in^2$

SECTION PROPERTIES

$k := 1000 \cdot lbf$

$h := 15.375 \cdot in$ — *Height of section*

$b := 36 \cdot in$ — *Width of section*

$d_{bar} := 0.50 \cdot in$ — *Bar diameter (#4)*

$cov := 2.25 \cdot in$ — *Clear cover*

$c := cov + 0.5 \cdot d_{bar} = 2.5 \cdot in$ — *Cover to center of bar*

$S_x := \frac{b \cdot h^2}{6} = 0.82 \cdot ft^3$ — *Section modulus*

BENDING MOMENTS

$M_{DC} := -10.52 \cdot k \cdot ft$ — *Dead Load Moment*

$M_{LL} := -4.46 \cdot k \cdot ft$ — *Live Load Moment*

$M_{PT} := 0 \cdot k \cdot ft$ — *Assume no PT Moment*

$F_{PRIM} := 0 \cdot k$ (enter positive)

$M_{PRIM} := 0 \cdot k \cdot ft$ (enter positive)

$M_{u1} := 1.25 \cdot M_{DC} + 1.75 \cdot M_{LL} + M_{PT}$ $\quad M_{u1} = -21 \cdot k \cdot ft$ — *Ultimate Design Moment (Strength I)*

$M_{u2} := 0.9 \cdot M_{DC} + 1.75 \cdot M_{LL} + M_{PT}$ $\quad M_{u2} = -17 \cdot k \cdot ft$

$M_u := \max\left(\left|M_{u1}\right|, \left|M_{u2}\right|\right)$ $\quad \boxed{M_u = 21 \cdot k \cdot ft}$

MINIMUM REINFORCEMENT CHECK (AASHTO LRFD 5.7.3.3.2)

$f_r := 0.24 \cdot \sqrt{\frac{f_c}{ksi}} \cdot ksi$ $\quad f_r = 0.700 \cdot ksi$ *Modulus of Rupture*

$f_{cpe} := \frac{F_{PRIM}}{h \cdot b} + \frac{M_{PRIM}}{S_x}$ $\quad f_{cpe} = 0.000 \cdot ksi$ *Compressive stress from PT*

$\gamma_1 := 1.6$ *Flexural cracking variability factor*

$\gamma_2 := 1.1$ *Prestress variability factor*

$\gamma_3 := 0.67$ *Yield/Ultimate ratio factor*

$M_{u3} := 1.33 \cdot M_u$ $\quad M_{u3} = 28 \cdot k \cdot ft$

$M_{u4} := \gamma_3 \cdot (\gamma_1 \cdot f_r + \gamma_2 \cdot f_{cpe}) \cdot S_x$ $\quad M_{u4} = 89 \cdot k \cdot ft$

$M_{u.min} := \max(\min(|M_{u3}|, |M_{u4}|), |M_u|)$ $\quad \boxed{M_{u.min} = 28 \cdot k \cdot ft}$

$$CHECK1 := \begin{cases} \text{"OK"} & \text{if } |M_u| \geq |M_{u.min}| \\ \text{"DESIGN FOR MIN. REQUIREMENT"} & \text{otherwise} \end{cases}$$

CHECK1 = "DESIGN FOR MIN. REQUIREMENT"

TRANSVERSE MILD REINFORCEMENT DESIGN (TOP OF SECTION)

$\phi := 0.9$

$d := h - c = 12.88 \cdot in$

$$a(A_s) := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$$

$$\phi M_n(A_s) := \phi \cdot A_s \cdot f_y \cdot \left(d - \frac{a(A_s)}{2}\right)$$

$A_s := \text{root}(M_{u.min} - \phi M_n(A'_s), A'_s, 0.0 \cdot in^2, 10 \cdot in^2)$ $\quad \boxed{A_s = 0.48 \cdot in^2}$

Try 3-#4:

$A_{s\_prov} := 3 \cdot 0.20 in^2 = 0.60 \cdot in^2$

$$CHECK2 := \begin{cases} \text{"OK"} & \text{if } A_{s\_prov} \geq A_s \\ \text{"NG"} & \text{otherwise} \end{cases}$$

CHECK2 = "OK"

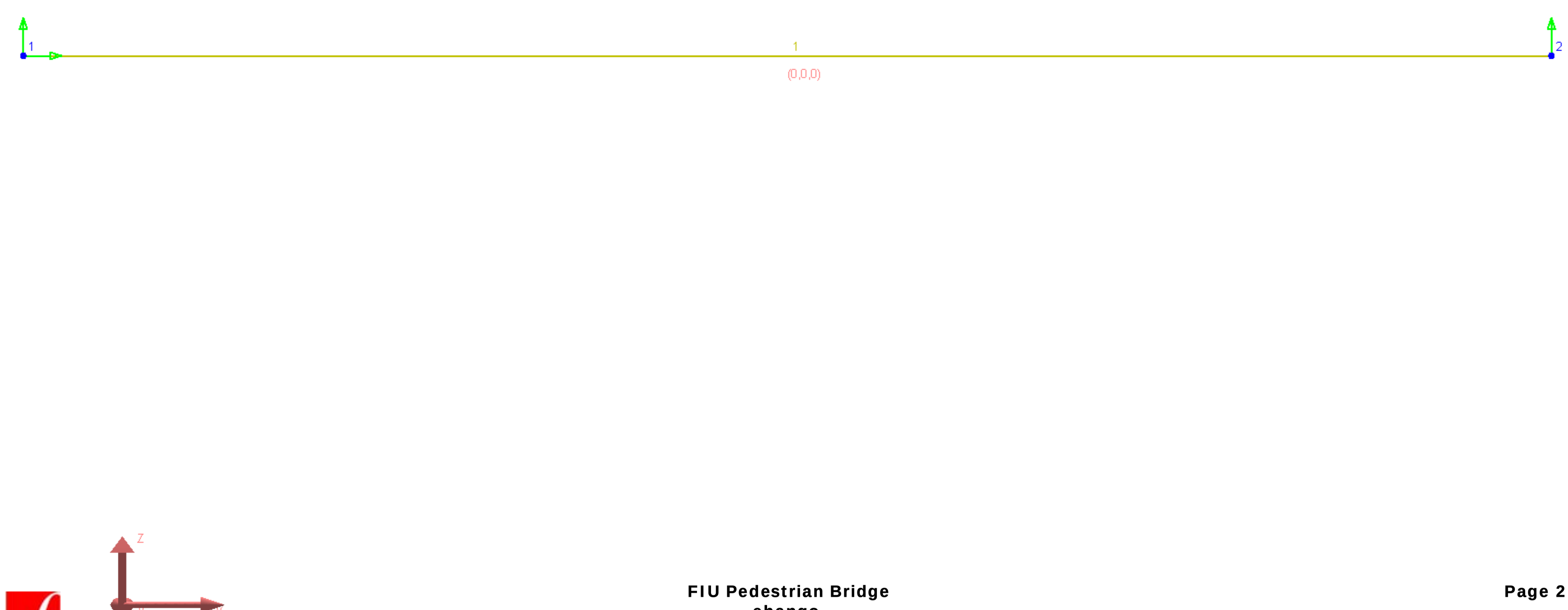
FIGG

Deck End Diaphragm Type IV

Monday, October 03, 2016
ehango
FIGG
424 North Calhoun Street
Tallahassee, Florida 32301
Tel: 850.224.7400

Graphics View 1

Zoom 1.953X



INPUT : Material Properties

Name	Modulus of Elasticity (kips/ft²)	Poisson Ratio	Shear Modulus (kips/ft²)	Unit Weight (kips/ft³)	Thermal Expansion (1/ °F *10^-6)	Assigned
Concrete	688,463.00	0.2000	286,859.58	0.1500	6.000000	Yes
PT	4,104,000.00	0.2000	1,710,000.00	0.0000	0.000000	Yes

INPUT : Sections

Name	Section Area (ft²)	Shear Area in yy (ft²)	Shear Area in zz (ft²)	Torsion Constant (ft^4)	Inertia Izz (ft^4)	Inertia Iyy (ft^4)	Plastic Modulus Zyy (ft³)	Plastic Modulus Zzz (ft³)	Perimeter (ft)	Material Time-Effect	Ductility	Residual Strength (%)	Assigned
1	3.95	3.95	3.95	0.74	8.23	0.21	0.00	0.00	11.58	Concrete	50.	0.	Yes

INPUT : Joints

ID	X (ft)	Y (ft)	Z (ft)	Translation DOF [y fixed]	Rotation DOF [x, z fixed]	Displacement UCS	Assignment
1	-15.8333	0.0000	0.0000	x, z fixed	all free	Global	Yes
2	15.8333	0.0000	0.0000	z fixed	all free	Global	Yes

INPUT : Members

ID	I-Joint	J-Joint	Span	Type	Section at Start	Section at End	Material	Prestress Force (kips)	Length (ft)	Rigid Zone from Start (x/L)	Rigid Zone from End (x/L)	Orientation Angle (deg)	Casting (day)	Structure Group
1	1	2	-	Beam	1	1	Concrete	0.	31.6666	0.00	0.00	0.00	0	Cast

INPUT : Tendons

Tendon Name	Design Group	Material	Exposure	Strand Area (per strand)	# of Strands	Jacking Force @ Start (kips)	Jacking Force @ End (kips)	Jacking End	Anchor Set (ft)	Wobble Coefficient (per ft)	Curvature Friction Coefficient	Peak Stress Ratio -	Peak Stress Ratio -	Elongation After Pull 1	Elongation After Pull 2	Elongation @ Left of	Elongation @ Right of
1	1	PT	Post-	0.0015	4	187.	0	Start	0.0313	0.0002	0.2300	0.7000	0.7400	.2298	0	0	0
2	1	PT	Post-	0.0015	4	0	187.	End	0.0313	0.0002	0.2300	0.7000	0.7400	.2298	0	0	0

INPUT : More Material Properties

Name	Yield Stress (kips/ft²)	Post-yield to Initial Slope Ratio	Concrete Strength Specimen	Concrete fc28 or Steel Fu (kips/ft²)	Concrete Cement Hardening Type	Tendon GUTS (kips/ft²)	Material Time-Effect	Assigned
Concrete	0.00	0.020	Cylinder	1,224.00	Normal	0.00	Concrete	Yes

INPUT : More Material Properties

Name	Yield Stress (kips/ft²)	Post-yield to Initial Slope Ratio	Concrete Strength Specimen	Concrete fc28 or Steel Fu (kips/ft²)	Concrete Cement Hardening Type	Tendon GUTS (kips/ft²)	Material Time-Effect	Assigned
PT	34,992.00	0.020	Cylinder	38,880.00	Not Concrete	38,880.00	270ksi Low-Lax	Yes

INPUT : CEB-FIP 90

Name	Creep Factor	Shrinkage Factor	Relaxation Factor	Steel Relaxation Type	Assigned
Concrete	1.0000	1.0000	1.0000	Custom	Yes
270ksi Low-Lax	1.0000	1.0000	1.0000	Custom	Yes

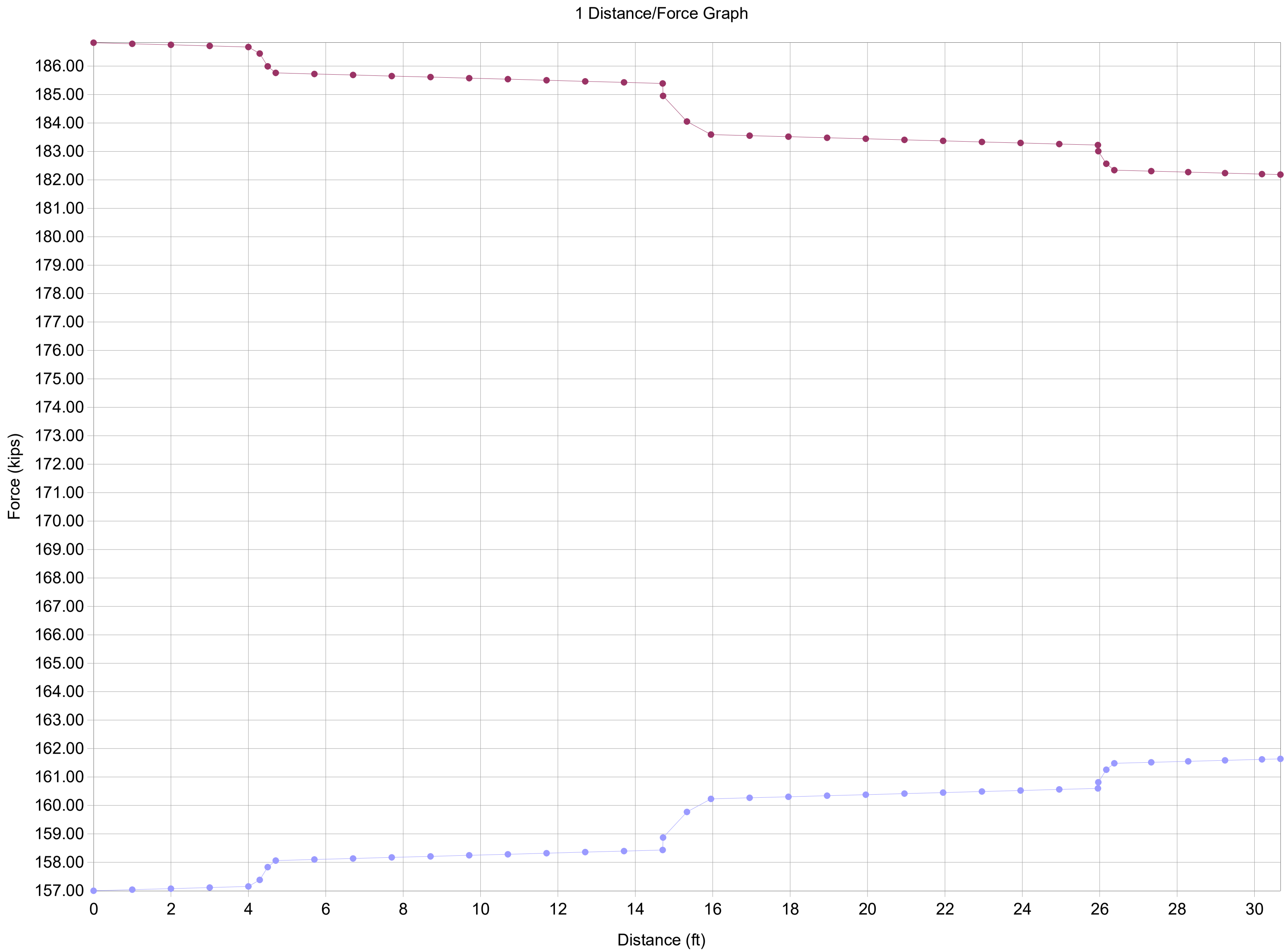
TENDON 1

Point Type	Reference Object Type	Reference Object or Range	Offset X (ft)	Offset Y (ft)	Offset Z (ft)	X Reference	Y Reference	Z Reference	Curvature Type			Width
geometry	member	1	0.5000	-1.2500	-0.4167	Start	Reference Line	+Z1 Local Edge	No Curve			
geometry	member	1	5.0000	-1.2500	-0.4167	Start	Reference Line	+Z1 Local Edge	Circular Radius	20.0000		
geometry	member	1	15.8333	-1.2500	-0.6406	Start	Reference Line	+Z1 Local Edge	Circular Radius	30.0000		
geometry	member	1	26.6667	-1.2500	-0.4167	Start	Reference Line	+Z1 Local Edge	Circular Radius	20.0000		
geometry	member	1	31.1667	-1.2500	-0.4167	Start	Reference Line	+Z1 Local Edge	No Curve			

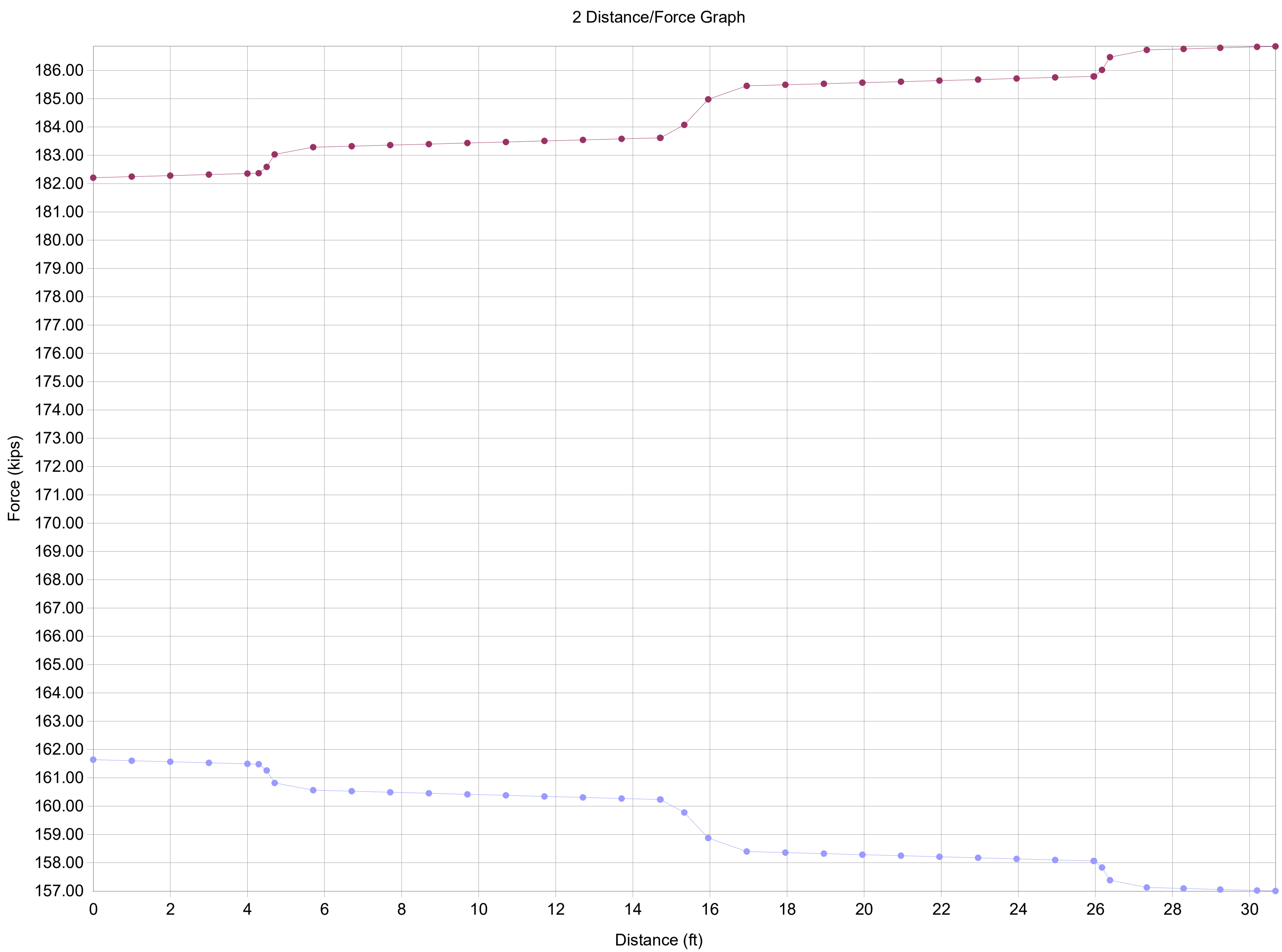
TENDON 2

Point Type	Reference Object Type	Reference Object or Range	Offset X (ft)	Offset Y (ft)	Offset Z (ft)	X Reference	Y Reference	Z Reference	Curvature Type			Width
geometry	member	1	0.5000	-1.2500	-0.4167	Start	Reference Line	+Z1 Local Edge	No Curve			
geometry	member	1	5.0000	-1.2500	-0.4167	Start	Reference Line	+Z1 Local Edge	Circular Radius	20.0000		
geometry	member	1	15.8333	-1.2500	-0.6406	Start	Reference Line	+Z1 Local Edge	Circular Radius	30.0000		
geometry	member	1	26.6667	-1.2500	-0.4167	Start	Reference Line	+Z1 Local Edge	Circular Radius	20.0000		
geometry	member	1	31.1667	-1.2500	-0.4167	Start	Reference Line	+Z1 Local Edge	No Curve			

TENDON 1, Graph



TENDON 2, Graph



TENDON 1, Calculations

Segment	Length (ft)	X (ft)	Y (ft)	Z (ft)	Force (kips)	Force after Anchor-Set (kips)	Angle Change (deg)	Force Loss (%)
1	0.0000	-15.3333	-1.2500	-0.0217	186.8240	157.0013	0.0000	0.0000
1-2	1.0000	-14.3333	-1.2500	-0.0217	186.7867	157.0386	0.0000	0.0200
1-2	2.0000	-13.3333	-1.2500	-0.0217	186.7493	157.0760	0.0000	0.0200
1-2	3.0000	-12.3333	-1.2500	-0.0217	186.7120	157.1133	0.0000	0.0200
1-2	4.0000	-11.3333	-1.2500	-0.0217	186.6746	157.1507	0.0000	0.0200
2	4.2933	-11.0400	-1.2500	-0.0217	186.4420	157.3833	0.2960	0.1246
2	4.5000	-10.8333	-1.2500	-0.0228	185.9918	157.8335	0.5920	0.2415
2	4.7066	-10.6267	-1.2500	-0.0260	185.7632	158.0620	0.2960	0.1229
2-3	5.7066	-9.6269	-1.2500	-0.0466	185.7261	158.0992	0.0000	0.0200
2-3	6.7066	-8.6271	-1.2500	-0.0673	185.6889	158.1363	0.0000	0.0200
2-3	7.7066	-7.6273	-1.2500	-0.0880	185.6518	158.1735	0.0000	0.0200
2-3	8.7066	-6.6275	-1.2500	-0.1086	185.6147	158.2106	0.0000	0.0200
2-3	9.7066	-5.6278	-1.2500	-0.1293	185.5775	158.2477	0.0000	0.0200
2-3	10.7066	-4.6280	-1.2500	-0.1500	185.5404	158.2848	0.0000	0.0200
2-3	11.7066	-3.6282	-1.2500	-0.1706	185.5033	158.3219	0.0000	0.0200
2-3	12.7066	-2.6284	-1.2500	-0.1913	185.4662	158.3590	0.0000	0.0200
2-3	13.7066	-1.6286	-1.2500	-0.2119	185.4291	158.3961	0.0000	0.0200
2-3	14.7066	-0.6288	-1.2500	-0.2326	185.3921	158.4332	0.0000	0.0200
3	14.7156	-0.6199	-1.2500	-0.2328	184.9517	158.8736	0.5920	0.2375
3	15.3355	0.0000	-1.2500	-0.2392	184.0519	159.7734	1.1840	0.4865
3	15.9554	0.6199	-1.2500	-0.2328	183.5923	160.2330	0.5920	0.2497
3-4	16.9554	1.6197	-1.2500	-0.2121	183.5555	160.2697	0.0000	0.0200
3-4	17.9554	2.6195	-1.2500	-0.1915	183.5188	160.3064	0.0000	0.0200
3-4	18.9554	3.6193	-1.2500	-0.1708	183.4821	160.3431	0.0000	0.0200
3-4	19.9554	4.6190	-1.2500	-0.1501	183.4454	160.3798	0.0000	0.0200
3-4	20.9554	5.6188	-1.2500	-0.1295	183.4088	160.4165	0.0000	0.0200
3-4	21.9554	6.6186	-1.2500	-0.1088	183.3721	160.4532	0.0000	0.0200
3-4	22.9554	7.6184	-1.2500	-0.0881	183.3354	160.4899	0.0000	0.0200
3-4	23.9554	8.6182	-1.2500	-0.0675	183.2987	160.5265	0.0000	0.0200
3-4	24.9554	9.6180	-1.2500	-0.0468	183.2621	160.5632	0.0000	0.0200
3-4	25.9554	10.6178	-1.2500	-0.0262	183.2254	160.5998	0.0000	0.0200
4	25.9645	10.6268	-1.2500	-0.0260	183.0075	160.8177	0.2960	0.1189

TENDON 1, Calculations

Segment	Length (ft)	X (ft)	Y (ft)	Z (ft)	Force (kips)	Force after Anchor-Set (kips)	Angle Change (deg)	Force Loss (%)	Containing Element	Additional Info.
4	26.1711	10.8334	-1.2500	-0.0228	182.5656	161.2597	0.5920	0.2415		
4	26.3777	11.0401	-1.2500	-0.0217	182.3413	161.4840	0.2960	0.1229		
5	27.3318	11.9941	-1.2500	-0.0217	182.3065	161.5188	0.0000	0.0191		
5	28.2859	12.9482	-1.2500	-0.0217	182.2717	161.5536	0.0000	0.0191		
5	29.2400	13.9023	-1.2500	-0.0217	182.2369	161.5884	0.0000	0.0191		
5	30.1941	14.8564	-1.2500	-0.0217	182.2021	161.6231	0.0000	0.0191		
5	30.6711	15.3334	-1.2500	-0.0217	182.1848	161.6405	0.0000	0.0095		

TENDON 2, Calculations

Segment	Length (ft)	X (ft)	Y (ft)	Z (ft)	Force (kips)	Force after Anchor-Set (kips)	Angle Change (deg)	Force Loss (%)
1	0.0000	-15.3333	-1.2500	-0.0217	182.2138	161.6442	0.0000	0.0200
1-2	1.0000	-14.3333	-1.2500	-0.0217	182.2502	161.6078	0.0000	0.0200
1-2	2.0000	-13.3333	-1.2500	-0.0217	182.2867	161.5713	0.0000	0.0200
1-2	3.0000	-12.3333	-1.2500	-0.0217	182.3231	161.5349	0.0000	0.0200
1-2	4.0000	-11.3333	-1.2500	-0.0217	182.3596	161.4984	0.0000	0.0059
2	4.2933	-11.0400	-1.2500	-0.0217	182.3703	161.4877	0.2960	0.1229
2	4.5000	-10.8333	-1.2500	-0.0228	182.5947	161.2633	0.5920	0.2415
2	4.7066	-10.6267	-1.2500	-0.0260	183.0367	160.8213	0.2960	0.1387
2-3	5.7066	-9.6269	-1.2500	-0.0466	183.2910	160.5671	0.0000	0.0200
2-3	6.7066	-8.6271	-1.2500	-0.0673	183.3276	160.5304	0.0000	0.0200
2-3	7.7066	-7.6273	-1.2500	-0.0880	183.3643	160.4937	0.0000	0.0200
2-3	8.7066	-6.6275	-1.2500	-0.1086	183.4010	160.4571	0.0000	0.0200
2-3	9.7066	-5.6278	-1.2500	-0.1293	183.4376	160.4204	0.0000	0.0200
2-3	10.7066	-4.6280	-1.2500	-0.1500	183.4743	160.3837	0.0000	0.0200
2-3	11.7066	-3.6282	-1.2500	-0.1706	183.5110	160.3470	0.0000	0.0200
2-3	12.7066	-2.6284	-1.2500	-0.1913	183.5477	160.3103	0.0000	0.0200
2-3	13.7066	-1.6286	-1.2500	-0.2119	183.5845	160.2736	0.0000	0.0200
2-3	14.7066	-0.6288	-1.2500	-0.2326	183.6212	160.2368	0.0000	0.0002
3	14.7156	-0.6199	-1.2500	-0.2328	183.6215	160.2365	0.5920	0.2497
3	15.3355	0.0000	-1.2500	-0.2392	184.0812	159.7768	1.1840	0.4865
3	15.9554	0.6199	-1.2500	-0.2328	184.9811	158.8769	0.5920	0.2573
3-4	16.9554	1.6197	-1.2500	-0.2121	185.4583	158.3997	0.0000	0.0200

TENDON 2, Calculations

Segment	Length (ft)	X (ft)	Y (ft)	Z (ft)	Force (kips)	Force after Anchor-Set (kips)	Angle Change (deg)	Force Loss (%)	Containing Element	Additional Info.
3-4	17.9554	2.6195	-1.2500	-0.1915	185.4954	158.3626	0.0000	0.0200		
3-4	18.9554	3.6193	-1.2500	-0.1708	185.5325	158.3255	0.0000	0.0200		
3-4	19.9554	4.6190	-1.2500	-0.1501	185.5697	158.2884	0.0000	0.0200		
3-4	20.9554	5.6188	-1.2500	-0.1295	185.6068	158.2512	0.0000	0.0200		
3-4	21.9554	6.6186	-1.2500	-0.1088	185.6439	158.2141	0.0000	0.0200		
3-4	22.9554	7.6184	-1.2500	-0.0881	185.6810	158.1770	0.0000	0.0200		
3-4	23.9554	8.6182	-1.2500	-0.0675	185.7182	158.1398	0.0000	0.0200		
3-4	24.9554	9.6180	-1.2500	-0.0468	185.7553	158.1027	0.0000	0.0200		
3-4	25.9554	10.6178	-1.2500	-0.0262	185.7925	158.0655	0.0000	0.0002		
4	25.9645	10.6268	-1.2500	-0.0260	185.7928	158.0652	0.2960	0.1229		
4	26.1711	10.8334	-1.2500	-0.0228	186.0214	157.8366	0.5920	0.2415		
4	26.3777	11.0401	-1.2500	-0.0217	186.4717	157.3863	0.2960	0.1378		
5	27.3318	11.9941	-1.2500	-0.0217	186.7290	157.1290	0.0000	0.0191		
5	28.2859	12.9482	-1.2500	-0.0217	186.7647	157.0934	0.0000	0.0191		
5	29.2400	13.9023	-1.2500	-0.0217	186.8003	157.0577	0.0000	0.0191		
5	30.1941	14.8564	-1.2500	-0.0217	186.8359	157.0221	0.0000	0.0095		
5	30.6711	15.3334	-1.2500	-0.0217	186.8538	157.0043	0.0000	0.0000		

Stage Summary

Stage 1 'Stage 1' Day = 14 Temp = 70°F Rel Hum = 75 %

Currently NO Step in this Stage.

Stage 2 'Stage 2' Day = 28 Temp = 70°F Rel Hum = 75 %

Step 1 : Cast

Construct Structure Groups

Cast

NO Support Activity.

NO Slave/Master Activity.

NO Tendon Activity.

NO Displacement Initialization Activity.

NO Load Activity.

Step 2 : Stress PT

No Construction activity

NO Support Activity.

NO Slave/Master Activity.

Tendon Activity

1 Stress

2 Stress

NO Displacement Initialization Activity.

NO Load Activity.

Stage 3 'Stage 3' Day = 97 Temp = 70°F Rel Hum = 75 %

Currently NO Step in this Stage.

Stage 4 'Stage 4' Day = 105 Temp = 70°F Rel Hum = 75 %

Currently NO Step in this Stage.

Stage 5 'Stage 5' Day = 120 Temp = 70°F Rel Hum = 75 %

Currently NO Step in this Stage.

Stage 6 'Stage 6' Day = 125 Temp = 70°F Rel Hum = 75 %

Currently NO Step in this Stage.

Stage 7 'EOC' Day = 360 Temp = 70°F Rel Hum = 75 %

Currently NO Step in this Stage.

Stage 8 'Stage 9' Day = 500 Temp = 70°F   Rel Hum = 75 %

Currently NO Step in this Stage.

Stage 9 'Stage 10' Day = 1000 Temp = 70°F   Rel Hum = 75 %

Currently NO Step in this Stage.

Stage 10 'Stage 11' Day = 5000 Temp = 70°F   Rel Hum = 75 %

Currently NO Step in this Stage.

Stage 11 'D10K' Day = 10000 Temp = 70°F   Rel Hum = 75 %

Currently NO Step in this Stage.

Tendon Force Variation Along Length: 1

Tendon	Distance	Stage	Member	Force in Tendon (kips)	Fx (kips)	Fy (kips)	Fz (kips)	X (ft)	Y (ft)	Z (ft)
1	0.0000	D10K: Other PT Losses	1	154.1600	154.1600	0.0000	0.0000	0.5000	-1.2500	-0.0217
1	1.0733	D10K: Other PT Losses	1	154.1931	154.1931	0.0000	0.0000	1.5733	-1.2500	-0.0217
1	2.1467	D10K: Other PT Losses	1	154.2261	154.2261	0.0000	0.0000	2.6467	-1.2500	-0.0217
1	3.2200	D10K: Other PT Losses	1	154.2592	154.2592	0.0000	0.0000	3.7200	-1.2500	-0.0217
1	4.2933	D10K: Other PT Losses	1	154.2922	154.2892	0.0000	-0.9643	4.7933	-1.2500	-0.0217
1	4.5433	D10K: Other PT Losses	1	154.5209	154.4881	0.0000	-3.1834	5.0433	-1.2500	-0.0233
1	5.5607	D10K: Other PT Losses	1	155.0576	155.0247	0.0000	-3.1944	6.0604	-1.2500	-0.0442
1	6.5780	D10K: Other PT Losses	1	155.0887	155.0558	0.0000	-3.1951	7.0775	-1.2500	-0.0652
1	7.5953	D10K: Other PT Losses	1	155.1198	155.0868	0.0000	-3.1957	8.0946	-1.2500	-0.0861
1	8.6126	D10K: Other PT Losses	1	155.1508	155.1179	0.0000	-3.1964	9.1117	-1.2500	-0.1071
1	9.6299	D10K: Other PT Losses	1	155.1819	155.1489	0.0000	-3.1970	10.1288	-1.2500	-0.1281
1	10.6472	D10K: Other PT Losses	1	155.2129	155.1800	0.0000	-3.1976	11.1459	-1.2500	-0.1490
1	11.6646	D10K: Other PT Losses	1	155.2439	155.2110	0.0000	-3.1983	12.1630	-1.2500	-0.1700
1	12.6819	D10K: Other PT Losses	1	155.2748	155.2419	0.0000	-3.1989	13.1801	-1.2500	-0.1909
1	13.6992	D10K: Other PT Losses	1	155.3053	155.2724	0.0000	-3.1995	14.1972	-1.2500	-0.2119
1	14.7165	D10K: Other PT Losses	1	155.3358	155.3148	0.0000	-2.5530	15.2143	-1.2500	-0.2328
1	14.9665	D10K: Other PT Losses	1	155.4868	155.4856	0.0000	-0.6118	15.4643	-1.2500	-0.2370
1	15.4665	D10K: Other PT Losses	1	155.9310	155.9187	0.0000	1.9540	15.9643	-1.2500	-0.2389
1	15.9545	D10K: Other PT Losses	1	156.5080	156.4745	0.0000	3.2339	16.4523	-1.2500	-0.2328
1	16.9555	D10K: Other PT Losses	1	156.8142	156.7807	0.0000	3.2403	17.4531	-1.2500	-0.2121
1	17.9565	D10K: Other PT Losses	1	156.8437	156.8102	0.0000	3.2409	18.4538	-1.2500	-0.1914
1	18.9575	D10K: Other PT Losses	1	156.8732	156.8398	0.0000	3.2415	19.4546	-1.2500	-0.1708
1	19.9585	D10K: Other PT Losses	1	156.9028	156.8693	0.0000	3.2421	20.4554	-1.2500	-0.1501
1	20.9595	D10K: Other PT Losses	1	156.9323	156.8988	0.0000	3.2427	21.4562	-1.2500	-0.1294
1	21.9605	D10K: Other PT Losses	1	156.9618	156.9283	0.0000	3.2433	22.4570	-1.2500	-0.1087
1	22.9615	D10K: Other PT Losses	1	156.9913	156.9578	0.0000	3.2439	23.4577	-1.2500	-0.0880
1	23.9625	D10K: Other PT Losses	1	157.0208	156.9873	0.0000	3.2445	24.4585	-1.2500	-0.0673
1	24.9635	D10K: Other PT Losses	1	157.0503	157.0168	0.0000	3.2452	25.4593	-1.2500	-0.0467
1	25.9645	D10K: Other PT Losses	1	157.0798	157.0635	0.0000	2.2642	26.4601	-1.2500	-0.0260
1	26.2145	D10K: Other PT Losses	1	157.2973	157.2973	0.0000	0.0235	26.7101	-1.2500	-0.0224
1	27.3286	D10K: Other PT Losses	1	157.8063	157.8063	0.0000	0.0236	27.8242	-1.2500	-0.0222
1	28.4428	D10K: Other PT Losses	1	157.8385	157.8385	0.0000	0.0236	28.9384	-1.2500	-0.0220
1	30.6711	D10K: Other PT Losses	1	157.9031	157.9031	0.0000	0.0236	31.1667	-1.2500	-0.0217

Tendon Force Variation Along Length: 2

Tendon	Distance	Stage	Member	Force in Tendon (kips)	Fx (kips)	Fy (kips)	Fz (kips)	X (ft)	Y (ft)	Z (ft)
2	0.0000	D10K: Other PT Losses	1	157.8508	157.8508	0.0000	0.0000	0.5000	-1.2500	-0.0217
2	1.0733	D10K: Other PT Losses	1	157.8197	157.8197	0.0000	0.0000	1.5733	-1.2500	-0.0217
2	2.1467	D10K: Other PT Losses	1	157.7887	157.7887	0.0000	0.0000	2.6467	-1.2500	-0.0217
2	3.2200	D10K: Other PT Losses	1	157.7575	157.7575	0.0000	0.0000	3.7200	-1.2500	-0.0217
2	4.2933	D10K: Other PT Losses	1	157.5178	157.5147	0.0000	-0.9845	4.7933	-1.2500	-0.0217
2	4.5433	D10K: Other PT Losses	1	157.0287	156.9953	0.0000	-3.2350	5.0433	-1.2500	-0.0233
2	5.5607	D10K: Other PT Losses	1	156.9987	156.9654	0.0000	-3.2344	6.0604	-1.2500	-0.0442
2	6.5780	D10K: Other PT Losses	1	156.9687	156.9354	0.0000	-3.2338	7.0775	-1.2500	-0.0652
2	7.5953	D10K: Other PT Losses	1	156.9387	156.9054	0.0000	-3.2332	8.0946	-1.2500	-0.0861
2	8.6126	D10K: Other PT Losses	1	156.9087	156.8754	0.0000	-3.2326	9.1117	-1.2500	-0.1071
2	9.6299	D10K: Other PT Losses	1	156.8787	156.8454	0.0000	-3.2320	10.1288	-1.2500	-0.1281
2	10.6472	D10K: Other PT Losses	1	156.8487	156.8154	0.0000	-3.2313	11.1459	-1.2500	-0.1490
2	11.6646	D10K: Other PT Losses	1	156.8187	156.7854	0.0000	-3.2307	12.1630	-1.2500	-0.1700
2	12.6819	D10K: Other PT Losses	1	156.7886	156.7554	0.0000	-3.2301	13.1801	-1.2500	-0.1909
2	13.6992	D10K: Other PT Losses	1	156.7586	156.7253	0.0000	-3.2295	14.1972	-1.2500	-0.2119
2	14.7165	D10K: Other PT Losses	1	156.5868	156.5657	0.0000	-2.5735	15.2143	-1.2500	-0.2328
2	14.9665	D10K: Other PT Losses	1	156.1531	156.1519	0.0000	-0.6145	15.4643	-1.2500	-0.2370
2	15.4665	D10K: Other PT Losses	1	155.5738	155.5616	0.0000	1.9495	15.9643	-1.2500	-0.2389
2	15.9545	D10K: Other PT Losses	1	155.2793	155.2461	0.0000	3.2086	16.4523	-1.2500	-0.2328
2	16.9555	D10K: Other PT Losses	1	155.2489	155.2158	0.0000	3.2079	17.4531	-1.2500	-0.2121
2	17.9565	D10K: Other PT Losses	1	155.2184	155.1853	0.0000	3.2073	18.4538	-1.2500	-0.1914
2	18.9575	D10K: Other PT Losses	1	155.1879	155.1547	0.0000	3.2067	19.4546	-1.2500	-0.1708
2	19.9585	D10K: Other PT Losses	1	155.1573	155.1242	0.0000	3.2060	20.4554	-1.2500	-0.1501
2	20.9595	D10K: Other PT Losses	1	155.1268	155.0936	0.0000	3.2054	21.4562	-1.2500	-0.1294
2	21.9605	D10K: Other PT Losses	1	155.0962	155.0631	0.0000	3.2048	22.4570	-1.2500	-0.1087
2	22.9615	D10K: Other PT Losses	1	155.0656	155.0325	0.0000	3.2041	23.4577	-1.2500	-0.0880
2	23.9625	D10K: Other PT Losses	1	155.0350	155.0020	0.0000	3.2035	24.4585	-1.2500	-0.0673
2	24.9635	D10K: Other PT Losses	1	155.0045	154.9714	0.0000	3.2029	25.4593	-1.2500	-0.0467
2	25.9645	D10K: Other PT Losses	1	154.7539	154.7378	0.0000	2.2306	26.4601	-1.2500	-0.0260
2	26.2145	D10K: Other PT Losses	1	154.2424	154.2424	0.0000	0.0231	26.7101	-1.2500	-0.0224
2	27.3286	D10K: Other PT Losses	1	154.2081	154.2081	0.0000	0.0231	27.8242	-1.2500	-0.0222
2	28.4428	D10K: Other PT Losses	1	154.1738	154.1738	0.0000	0.0231	28.9384	-1.2500	-0.0220
2	30.6711	D10K: Other PT Losses	1	154.1052	154.1052	0.0000	0.0230	31.1667	-1.2500	-0.0217

Tendon Force Variation Along Length: 1

Tendon	Distance	Stage	Member	Force in Tendon (kips)	Fx (kips)	Fy (kips)	Fz (kips)	X (ft)	Y (ft)	Z (ft)
1	0.0000	EOC: Other PT Losses	1	155.4268	155.4268	0.0000	0.0000	0.5000	-1.2500	-0.0217
1	1.0733	EOC: Other PT Losses	1	155.4627	155.4627	0.0000	0.0000	1.5733	-1.2500	-0.0217
1	2.1467	EOC: Other PT Losses	1	155.4986	155.4986	0.0000	0.0000	2.6467	-1.2500	-0.0217
1	3.2200	EOC: Other PT Losses	1	155.5345	155.5345	0.0000	0.0000	3.7200	-1.2500	-0.0217
1	4.2933	EOC: Other PT Losses	1	155.5704	155.5674	0.0000	-0.9723	4.7933	-1.2500	-0.0217
1	4.5433	EOC: Other PT Losses	1	155.8188	155.7858	0.0000	-3.2101	5.0433	-1.2500	-0.0233
1	5.5607	EOC: Other PT Losses	1	156.4023	156.3691	0.0000	-3.2221	6.0604	-1.2500	-0.0442
1	6.5780	EOC: Other PT Losses	1	156.4361	156.4029	0.0000	-3.2228	7.0775	-1.2500	-0.0652
1	7.5953	EOC: Other PT Losses	1	156.4699	156.4367	0.0000	-3.2235	8.0946	-1.2500	-0.0861
1	8.6126	EOC: Other PT Losses	1	156.5037	156.4705	0.0000	-3.2242	9.1117	-1.2500	-0.1071
1	9.6299	EOC: Other PT Losses	1	156.5375	156.5042	0.0000	-3.2249	10.1288	-1.2500	-0.1281
1	10.6472	EOC: Other PT Losses	1	156.5712	156.5380	0.0000	-3.2256	11.1459	-1.2500	-0.1490
1	11.6646	EOC: Other PT Losses	1	156.6050	156.5717	0.0000	-3.2263	12.1630	-1.2500	-0.1700
1	12.6819	EOC: Other PT Losses	1	156.6386	156.6054	0.0000	-3.2270	13.1801	-1.2500	-0.1909
1	13.6992	EOC: Other PT Losses	1	156.6721	156.6388	0.0000	-3.2277	14.1972	-1.2500	-0.2119
1	14.7165	EOC: Other PT Losses	1	156.7055	156.6843	0.0000	-2.5755	15.2143	-1.2500	-0.2328
1	14.9665	EOC: Other PT Losses	1	156.8710	156.8698	0.0000	-0.6173	15.4643	-1.2500	-0.2370
1	15.4665	EOC: Other PT Losses	1	157.3582	157.3458	0.0000	1.9719	15.9643	-1.2500	-0.2389
1	15.9545	EOC: Other PT Losses	1	157.9915	157.9578	0.0000	3.2646	16.4523	-1.2500	-0.2328
1	16.9555	EOC: Other PT Losses	1	158.3278	158.2940	0.0000	3.2716	17.4531	-1.2500	-0.2121
1	17.9565	EOC: Other PT Losses	1	158.3603	158.3265	0.0000	3.2722	18.4538	-1.2500	-0.1914
1	18.9575	EOC: Other PT Losses	1	158.3927	158.3589	0.0000	3.2729	19.4546	-1.2500	-0.1708
1	19.9585	EOC: Other PT Losses	1	158.4252	158.3914	0.0000	3.2736	20.4554	-1.2500	-0.1501
1	20.9595	EOC: Other PT Losses	1	158.4576	158.4238	0.0000	3.2742	21.4562	-1.2500	-0.1294
1	21.9605	EOC: Other PT Losses	1	158.4901	158.4562	0.0000	3.2749	22.4570	-1.2500	-0.1087
1	22.9615	EOC: Other PT Losses	1	158.5225	158.4886	0.0000	3.2756	23.4577	-1.2500	-0.0880
1	23.9625	EOC: Other PT Losses	1	158.5549	158.5211	0.0000	3.2762	24.4585	-1.2500	-0.0673
1	24.9635	EOC: Other PT Losses	1	158.5873	158.5535	0.0000	3.2769	25.4593	-1.2500	-0.0467
1	25.9645	EOC: Other PT Losses	1	158.6197	158.6032	0.0000	2.2863	26.4601	-1.2500	-0.0260
1	26.2145	EOC: Other PT Losses	1	158.8594	158.8594	0.0000	0.0238	26.7101	-1.2500	-0.0224
1	27.3286	EOC: Other PT Losses	1	159.4215	159.4215	0.0000	0.0238	27.8242	-1.2500	-0.0222
1	28.4428	EOC: Other PT Losses	1	159.4571	159.4571	0.0000	0.0238	28.9384	-1.2500	-0.0220
1	30.6711	EOC: Other PT Losses	1	159.5284	159.5284	0.0000	0.0239	31.1667	-1.2500	-0.0217

Tendon Force Variation Along Length: 2

Tendon	Distance	Stage	Member	Force in Tendon (kips)	Fx (kips)	Fy (kips)	Fz (kips)	X (ft)	Y (ft)	Z (ft)
2	0.0000	EOC: Other PT Losses	1	159.4707	159.4707	0.0000	0.0000	0.5000	-1.2500	-0.0217
2	1.0733	EOC: Other PT Losses	1	159.4364	159.4364	0.0000	0.0000	1.5733	-1.2500	-0.0217
2	2.1467	EOC: Other PT Losses	1	159.4020	159.4020	0.0000	0.0000	2.6467	-1.2500	-0.0217
2	3.2200	EOC: Other PT Losses	1	159.3677	159.3677	0.0000	0.0000	3.7200	-1.2500	-0.0217
2	4.2933	EOC: Other PT Losses	1	159.1029	159.0998	0.0000	-0.9944	4.7933	-1.2500	-0.0217
2	4.5433	EOC: Other PT Losses	1	158.5635	158.5299	0.0000	-3.2667	5.0433	-1.2500	-0.0233
2	5.5607	EOC: Other PT Losses	1	158.5306	158.4969	0.0000	-3.2660	6.0604	-1.2500	-0.0442
2	6.5780	EOC: Other PT Losses	1	158.4976	158.4640	0.0000	-3.2653	7.0775	-1.2500	-0.0652
2	7.5953	EOC: Other PT Losses	1	158.4647	158.4310	0.0000	-3.2646	8.0946	-1.2500	-0.0861
2	8.6126	EOC: Other PT Losses	1	158.4317	158.3981	0.0000	-3.2639	9.1117	-1.2500	-0.1071
2	9.6299	EOC: Other PT Losses	1	158.3987	158.3651	0.0000	-3.2633	10.1288	-1.2500	-0.1281
2	10.6472	EOC: Other PT Losses	1	158.3658	158.3321	0.0000	-3.2626	11.1459	-1.2500	-0.1490
2	11.6646	EOC: Other PT Losses	1	158.3328	158.2992	0.0000	-3.2619	12.1630	-1.2500	-0.1700
2	12.6819	EOC: Other PT Losses	1	158.2998	158.2662	0.0000	-3.2612	13.1801	-1.2500	-0.1909
2	13.6992	EOC: Other PT Losses	1	158.2668	158.2332	0.0000	-3.2605	14.1972	-1.2500	-0.2119
2	14.7165	EOC: Other PT Losses	1	158.0781	158.0568	0.0000	-2.5980	15.2143	-1.2500	-0.2328
2	14.9665	EOC: Other PT Losses	1	157.6020	157.6007	0.0000	-0.6202	15.4643	-1.2500	-0.2370
2	15.4665	EOC: Other PT Losses	1	156.9664	156.9541	0.0000	1.9670	15.9643	-1.2500	-0.2389
2	15.9545	EOC: Other PT Losses	1	156.6435	156.6100	0.0000	3.2367	16.4523	-1.2500	-0.2328
2	16.9555	EOC: Other PT Losses	1	156.6104	156.5770	0.0000	3.2361	17.4531	-1.2500	-0.2121
2	17.9565	EOC: Other PT Losses	1	156.5772	156.5438	0.0000	3.2354	18.4538	-1.2500	-0.1914
2	18.9575	EOC: Other PT Losses	1	156.5440	156.5106	0.0000	3.2347	19.4546	-1.2500	-0.1708
2	19.9585	EOC: Other PT Losses	1	156.5108	156.4773	0.0000	3.2340	20.4554	-1.2500	-0.1501
2	20.9595	EOC: Other PT Losses	1	156.4775	156.4441	0.0000	3.2333	21.4562	-1.2500	-0.1294
2	21.9605	EOC: Other PT Losses	1	156.4443	156.4109	0.0000	3.2326	22.4570	-1.2500	-0.1087
2	22.9615	EOC: Other PT Losses	1	156.4110	156.3777	0.0000	3.2319	23.4577	-1.2500	-0.0880
2	23.9625	EOC: Other PT Losses	1	156.3778	156.3444	0.0000	3.2313	24.4585	-1.2500	-0.0673
2	24.9635	EOC: Other PT Losses	1	156.3445	156.3111	0.0000	3.2306	25.4593	-1.2500	-0.0467
2	25.9645	EOC: Other PT Losses	1	156.0721	156.0559	0.0000	2.2496	26.4601	-1.2500	-0.0260
2	26.2145	EOC: Other PT Losses	1	155.5163	155.5163	0.0000	0.0233	26.7101	-1.2500	-0.0224
2	27.3286	EOC: Other PT Losses	1	155.4791	155.4791	0.0000	0.0233	27.8242	-1.2500	-0.0222
2	28.4428	EOC: Other PT Losses	1	155.4418	155.4418	0.0000	0.0232	28.9384	-1.2500	-0.0220
2	30.6711	EOC: Other PT Losses	1	155.3672	155.3672	0.0000	0.0232	31.1667	-1.2500	-0.0217

Tendon Force Variation Along Length: 1

Tendon	Distance	Stage	Member	Force in Tendon (kips)	Fx (kips)	Fy (kips)	Fz (kips)	X (ft)	Y (ft)	Z (ft)
1	0.0000	Stage 2: Stress PT	1	157.2855	157.2855	0.0000	0.0000	0.5000	-1.2500	-0.0217
1	1.0733	Stage 2: Stress PT	1	157.3256	157.3256	0.0000	0.0000	1.5733	-1.2500	-0.0217
1	2.1467	Stage 2: Stress PT	1	157.3657	157.3657	0.0000	0.0000	2.6467	-1.2500	-0.0217
1	3.2200	Stage 2: Stress PT	1	157.4058	157.4058	0.0000	0.0000	3.7200	-1.2500	-0.0217
1	4.2933	Stage 2: Stress PT	1	157.4459	157.4428	0.0000	-0.9840	4.7933	-1.2500	-0.0217
1	4.5433	Stage 2: Stress PT	1	157.7234	157.6899	0.0000	-3.2494	5.0433	-1.2500	-0.0233
1	5.5607	Stage 2: Stress PT	1	158.3754	158.3418	0.0000	-3.2628	6.0604	-1.2500	-0.0442
1	6.5780	Stage 2: Stress PT	1	158.4132	158.3796	0.0000	-3.2636	7.0775	-1.2500	-0.0652
1	7.5953	Stage 2: Stress PT	1	158.4510	158.4174	0.0000	-3.2643	8.0946	-1.2500	-0.0861
1	8.6126	Stage 2: Stress PT	1	158.4888	158.4551	0.0000	-3.2651	9.1117	-1.2500	-0.1071
1	9.6299	Stage 2: Stress PT	1	158.5265	158.4929	0.0000	-3.2659	10.1288	-1.2500	-0.1281
1	10.6472	Stage 2: Stress PT	1	158.5643	158.5306	0.0000	-3.2667	11.1459	-1.2500	-0.1490
1	11.6646	Stage 2: Stress PT	1	158.6020	158.5684	0.0000	-3.2675	12.1630	-1.2500	-0.1700
1	12.6819	Stage 2: Stress PT	1	158.6398	158.6061	0.0000	-3.2682	13.1801	-1.2500	-0.1909
1	13.6992	Stage 2: Stress PT	1	158.6775	158.6438	0.0000	-3.2690	14.1972	-1.2500	-0.2119
1	14.7165	Stage 2: Stress PT	1	158.7152	158.6938	0.0000	-2.6085	15.2143	-1.2500	-0.2328
1	14.9665	Stage 2: Stress PT	1	158.9021	158.9009	0.0000	-0.6253	15.4643	-1.2500	-0.2370
1	15.4665	Stage 2: Stress PT	1	159.4523	159.4398	0.0000	1.9981	15.9643	-1.2500	-0.2389
1	15.9545	Stage 2: Stress PT	1	160.1683	160.1341	0.0000	3.3096	16.4523	-1.2500	-0.2328
1	16.9555	Stage 2: Stress PT	1	160.5488	160.5145	0.0000	3.3174	17.4531	-1.2500	-0.2121
1	17.9565	Stage 2: Stress PT	1	160.5855	160.5513	0.0000	3.3182	18.4538	-1.2500	-0.1914
1	18.9575	Stage 2: Stress PT	1	160.6223	160.5880	0.0000	3.3190	19.4546	-1.2500	-0.1708
1	19.9585	Stage 2: Stress PT	1	160.6590	160.6247	0.0000	3.3197	20.4554	-1.2500	-0.1501
1	20.9595	Stage 2: Stress PT	1	160.6957	160.6614	0.0000	3.3205	21.4562	-1.2500	-0.1294
1	21.9605	Stage 2: Stress PT	1	160.7325	160.6981	0.0000	3.3212	22.4570	-1.2500	-0.1087
1	22.9615	Stage 2: Stress PT	1	160.7692	160.7348	0.0000	3.3220	23.4577	-1.2500	-0.0880
1	23.9625	Stage 2: Stress PT	1	160.8059	160.7715	0.0000	3.3228	24.4585	-1.2500	-0.0673
1	24.9635	Stage 2: Stress PT	1	160.8426	160.8082	0.0000	3.3235	25.4593	-1.2500	-0.0467
1	25.9645	Stage 2: Stress PT	1	160.8792	160.8625	0.0000	2.3189	26.4601	-1.2500	-0.0260
1	26.2145	Stage 2: Stress PT	1	161.1516	161.1516	0.0000	0.0241	26.7101	-1.2500	-0.0224
1	27.3286	Stage 2: Stress PT	1	161.7915	161.7915	0.0000	0.0242	27.8242	-1.2500	-0.0222
1	28.4428	Stage 2: Stress PT	1	161.8321	161.8321	0.0000	0.0242	28.9384	-1.2500	-0.0220
1	30.6711	Stage 2: Stress PT	1	161.9134	161.9134	0.0000	0.0242	31.1667	-1.2500	-0.0217

Tendon Force Variation Along Length: 2

Tendon	Distance	Stage	Member	Force in Tendon (kips)	Fx (kips)	Fy (kips)	Fz (kips)	X (ft)	Y (ft)	Z (ft)
2	0.0000	Stage 2: Stress PT	1	161.8476	161.8476	0.0000	0.0000	0.5000	-1.2500	-0.0217
2	1.0733	Stage 2: Stress PT	1	161.8085	161.8085	0.0000	0.0000	1.5733	-1.2500	-0.0217
2	2.1467	Stage 2: Stress PT	1	161.7694	161.7694	0.0000	0.0000	2.6467	-1.2500	-0.0217
2	3.2200	Stage 2: Stress PT	1	161.7302	161.7302	0.0000	0.0000	3.7200	-1.2500	-0.0217
2	4.2933	Stage 2: Stress PT	1	161.4287	161.4256	0.0000	-1.0089	4.7933	-1.2500	-0.0217
2	4.5433	Stage 2: Stress PT	1	160.8156	160.7815	0.0000	-3.3131	5.0433	-1.2500	-0.0233
2	5.5607	Stage 2: Stress PT	1	160.7783	160.7442	0.0000	-3.3123	6.0604	-1.2500	-0.0442
2	6.5780	Stage 2: Stress PT	1	160.7410	160.7069	0.0000	-3.3115	7.0775	-1.2500	-0.0652
2	7.5953	Stage 2: Stress PT	1	160.7037	160.6696	0.0000	-3.3108	8.0946	-1.2500	-0.0861
2	8.6126	Stage 2: Stress PT	1	160.6664	160.6323	0.0000	-3.3100	9.1117	-1.2500	-0.1071
2	9.6299	Stage 2: Stress PT	1	160.6291	160.5950	0.0000	-3.3092	10.1288	-1.2500	-0.1281
2	10.6472	Stage 2: Stress PT	1	160.5918	160.5577	0.0000	-3.3084	11.1459	-1.2500	-0.1490
2	11.6646	Stage 2: Stress PT	1	160.5544	160.5203	0.0000	-3.3077	12.1630	-1.2500	-0.1700
2	12.6819	Stage 2: Stress PT	1	160.5171	160.4830	0.0000	-3.3069	13.1801	-1.2500	-0.1909
2	13.6992	Stage 2: Stress PT	1	160.4797	160.4457	0.0000	-3.3061	14.1972	-1.2500	-0.2119
2	14.7165	Stage 2: Stress PT	1	160.2663	160.2446	0.0000	-2.6340	15.2143	-1.2500	-0.2328
2	14.9665	Stage 2: Stress PT	1	159.7278	159.7266	0.0000	-0.6285	15.4643	-1.2500	-0.2370
2	15.4665	Stage 2: Stress PT	1	159.0098	158.9973	0.0000	1.9926	15.9643	-1.2500	-0.2389
2	15.9545	Stage 2: Stress PT	1	158.6452	158.6113	0.0000	3.2781	16.4523	-1.2500	-0.2328
2	16.9555	Stage 2: Stress PT	1	158.6081	158.5742	0.0000	3.2773	17.4531	-1.2500	-0.2121
2	17.9565	Stage 2: Stress PT	1	158.5710	158.5371	0.0000	3.2766	18.4538	-1.2500	-0.1914
2	18.9575	Stage 2: Stress PT	1	158.5338	158.5000	0.0000	3.2758	19.4546	-1.2500	-0.1708
2	19.9585	Stage 2: Stress PT	1	158.4967	158.4628	0.0000	3.2750	20.4554	-1.2500	-0.1501
2	20.9595	Stage 2: Stress PT	1	158.4595	158.4257	0.0000	3.2743	21.4562	-1.2500	-0.1294
2	21.9605	Stage 2: Stress PT	1	158.4223	158.3885	0.0000	3.2735	22.4570	-1.2500	-0.1087
2	22.9615	Stage 2: Stress PT	1	158.3852	158.3514	0.0000	3.2727	23.4577	-1.2500	-0.0880
2	23.9625	Stage 2: Stress PT	1	158.3480	158.3142	0.0000	3.2720	24.4585	-1.2500	-0.0673
2	24.9635	Stage 2: Stress PT	1	158.3108	158.2770	0.0000	3.2712	25.4593	-1.2500	-0.0467
2	25.9645	Stage 2: Stress PT	1	158.0063	157.9899	0.0000	2.2775	26.4601	-1.2500	-0.0260
2	26.2145	Stage 2: Stress PT	1	157.3855	157.3855	0.0000	0.0235	26.7101	-1.2500	-0.0224
2	27.3286	Stage 2: Stress PT	1	157.3439	157.3439	0.0000	0.0235	27.8242	-1.2500	-0.0222
2	28.4428	Stage 2: Stress PT	1	157.3023	157.3023	0.0000	0.0235	28.9384	-1.2500	-0.0220
2	30.6711	Stage 2: Stress PT	1	157.2191	157.2191	0.0000	0.0235	31.1667	-1.2500	-0.0217

Section II

Canopy End Diaphragms

Design Summary

Project: FIU Pedestrian Bridge

Project No. : 2262.03

Design Task: Canopy End Diaphragm Design Summary

Designer: Erika N. Hango, P.E.

Design Summary:

This binder contains the calculations performed for the RFC design of the canopy end diaphragms. The calculations were prepared in accordance with the project design criteria, AASHTO LRFD Bridge Design Specifications 7th Edition with 2015 Interim Revisions, FDOT Structures Design Guidelines (January 2015), and AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges 2nd Edition (2009). The intent of this design was to determine the required concrete dimensions and the reinforcement requirements for each diaphragm.

Tendon pullout reinforcement was provided for all tendons with vertical deviations near the anchorages. A limiting reinforcing steel stress of 30 ksi for direct tension was used for tendon pullout per FIGG Design Directive No. 26. A plate model with a 3”x3” discretization was created using RISA-3D (V14.0.0) for each diaphragm. Tension forces from these models were used to calculate the required bursting reinforcement at the exit face of the diaphragm. For the bursting reinforcement, a limiting reinforcing steel stress of 30 ksi was used per FIGG Design Directive No. 26.

A strut and tie model was developed for the Type II diaphragm to determine the steel area required for the tension tie between the two groups of anchorages. The results of this analysis were factored and applied to the Type III diaphragm design.

A transverse analysis was performed to check negative flexure at the root of the cantilevered diaphragm. Mild reinforcement was provided at the top of the section per AASHTO LRFD 5.7.3.2 & 5.7.3.3.2. Shrinkage and temperature reinforcement was calculated per AASHTO LRFD 5.10.8.

The diaphragm reinforcement requirements are summarized in Summary Table 1 on the next page.

Summary Table 1		
Diaphragm	Tendon Pullout (Per Tendon)	Bursting (Per Tendon)
Type I	4-#5	4-#9
Type II	4-#5	4-#9 & 1-#5
Type III	4-#5	4-#9 & 1-#5
Type IV	4-#5	4-#9

Canopy End Diaphragm - Type 1 & 4 - General Zone Reinforcement (12k6 Tendon)

Parameters

$f_{sallDT} := 30 \cdot ksi$ — *Allowable mild steel stress for direct tension per FIGG Design Directive No. 26*

$\%_{JACK} := 0.75$ — *Max % GUTS*

$f_{pu} := 270 \cdot ksi$ — *Ultimate PT Stress*

$A_{strand} := 0.217 \cdot in^2$ — *Area of a single strand*

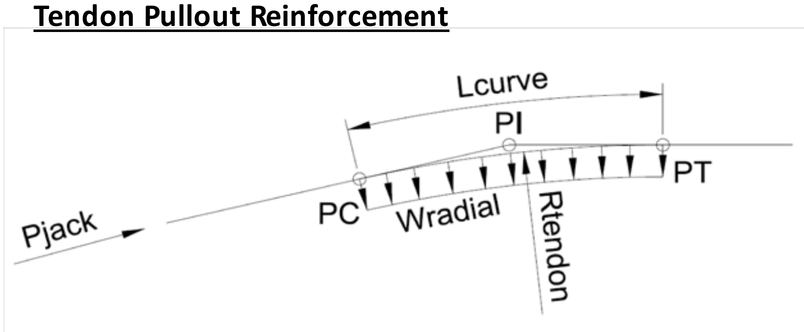
$N_{strand} := 12$ — *Number of single strands*

$R_{TENDON} := 15 \cdot ft$ — *Tendon radius of steel pipe*

$\alpha := 6.35 \cdot deg$ — *Degree of angle change*

$L_{CURVE} := R_{TENDON} \cdot \alpha$ $\quad L_{CURVE} = 1.66 \cdot ft$

Tendon Pullout Reinforcement



$P_{JACK} := \%_{JACK} \cdot (f_{pu} \cdot A_{strand} \cdot N_{strand})$ $\quad P_{JACK} = 527 \cdot kip$

$P_{JACK\_HOR} := P_{JACK} \cdot \cos(\alpha)$ $\quad P_{JACK\_HOR} = 524 \cdot kip$

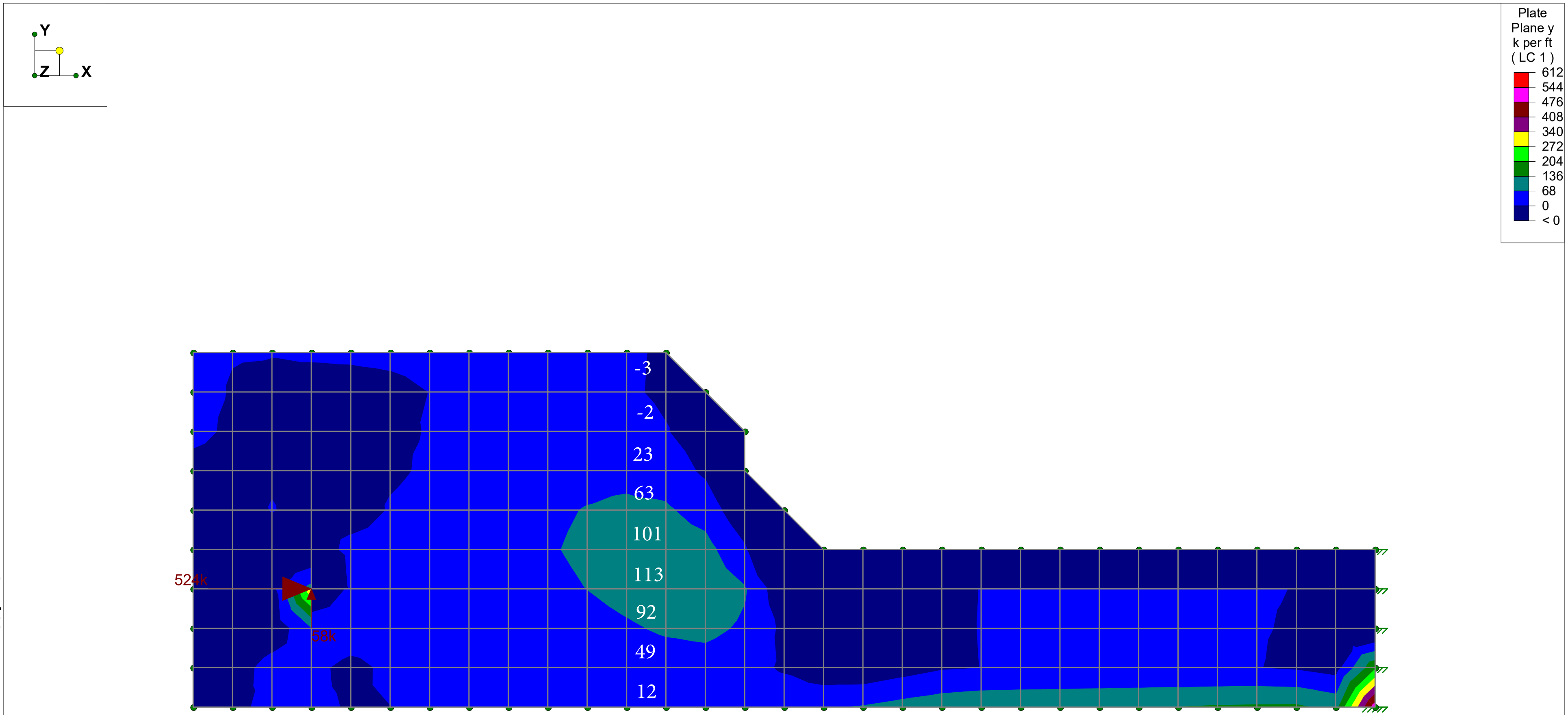
$P_{JACK\_VER} := P_{JACK} \cdot \sin(\alpha)$ $\quad P_{JACK\_VER} = 58 \cdot kip$

$$w_{RADIAL} := \frac{P_{JACK}}{R_{TENDON}}$$

$$A_{s\_reqd} := \frac{w_{RADIAL} \cdot L_{CURVE}}{f_{sallDT}}$$ $\quad A_{s\_reqd} = 1.95 \cdot in^2$ — *Steel Required per Tendon*

$A_{s\_prov} := 4 \cdot A_5 \cdot 2$ $\quad A_{s\_prov} = 2.48 \cdot in^2$ — *Steel Supplied per Tendon (4-#5 hat bars distributed between PT and PC)*

$Check1 := if(A_{s\_prov} \geq A_{s\_reqd}, "OK", "NG")$ $\quad Check1 = "OK"$



$T_{burst} = 0.25\ ft*(23 + 63+101+113+92+49+12\ k/ft) = 113\ kips$

Loads: BLC 1, PT
Results for LC 1, PT (Service)

FIGG	Canopy End Diaphragm 1&4	SK - 1
ENH		Sept 9, 2016 at 2:40 PM
2262.03		Canopy End Diaphragm 1_3x3_12k6.r3d

Canopy End Diaphragm - Type 1 & 4 - General Zone Reinforcement (12k6 Tendon)

Parameters

$f_{sallDT} := 30 \cdot ksi$ — *Allowable mild steel stress for direct tension per FIGG Design Directive No. 26*

$f_y := 60ksi$ — *Specified yield strength of reinforcement*

Bursting Reinforcement (AASHTO LRFD 5.10.9.6.3)

By inspection, service load case will govern.

$T_{burst} := 113kip$ $\quad T_{burst} = 113 \cdot kip$ — *See refined RISA-3D analysis for calculation of tensile force ahead of anchorage device*

$A_{sb\_reqd} := \dfrac{T_{burst}}{f_{sallDT}}$ $\quad A_{sb\_reqd} = 3.77 \cdot in^2$ — *Steel Required per Tendon*

$A_{sb\_prov} := 4 \cdot A_9$ $\quad A_{sb\_prov} = 4.00 \cdot in^2$ — *Steel Supplied per Tendon (4-#9 bars located at exit face of diaphragm)*

$Check2 := if(A_{sb\_prov} \geq A_{sb\_reqd}, "OK", "NG")$ $\quad \boxed{Check2 = "OK"}$

Canopy End Diaphragm - Type 2 & 3 - General Zone Reinforcement (12k6 Tendon)

Parameters

$f_{sallDT} := 30 \cdot ksi$ — *Allowable mild steel stress for direct tension per FIGG Design Directive No. 26*

$\%_{JACK} := 0.75$ — *Max % GUTS*

$f_{pu} := 270 \cdot ksi$ — *Ultimate PT Stress*

$A_{strand} := 0.217 \cdot in^2$ — *Area of a single strand*

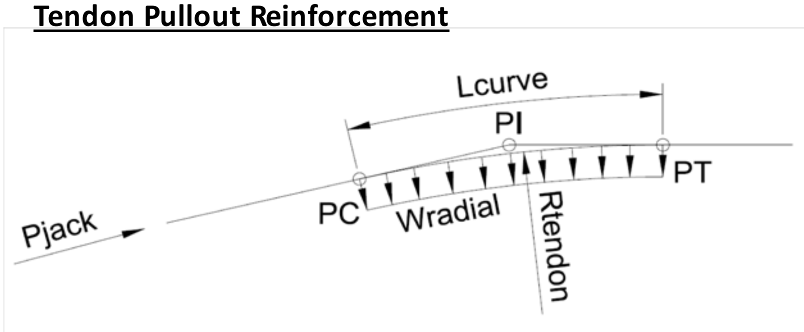
$N_{strand} := 12$ — *Number of single strands*

$R_{TENDON} := 10 \cdot ft$ — *Tendon radius of steel pipe*

$\alpha := 6.42 \cdot deg$ — *Degree of angle change*

$L_{CURVE} := R_{TENDON} \cdot \alpha$ $\quad L_{CURVE} = 1.12 \cdot ft$

Tendon Pullout Reinforcement



$P_{JACK} := \%_{JACK} \cdot (f_{pu} \cdot A_{strand} \cdot N_{strand})$ $\quad P_{JACK} = 527 \cdot kip$

$P_{JACK\_HOR} := P_{JACK} \cdot \cos(\alpha)$ $\quad P_{JACK\_HOR} = 524 \cdot kip$

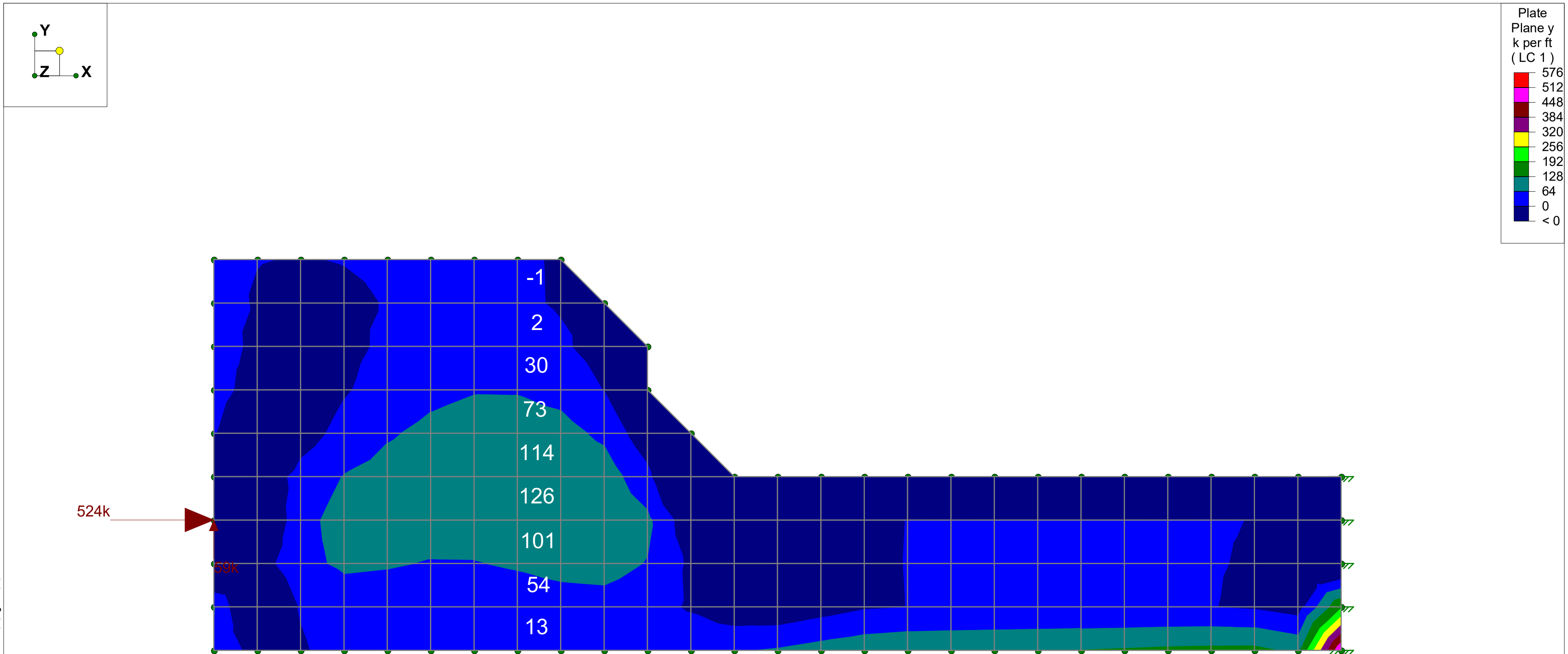
$P_{JACK\_VER} := P_{JACK} \cdot \sin(\alpha)$ $\quad P_{JACK\_VER} = 59 \cdot kip$

$$w_{RADIAL} := \frac{P_{JACK}}{R_{TENDON}}$$

$$A_{s\_reqd} := \frac{w_{RADIAL} \cdot L_{CURVE}}{f_{sallDT}}$$ $\quad A_{s\_reqd} = 1.97 \cdot in^2$ — *Steel Required per Tendon*

$A_{s\_prov} := 4 \cdot A_5 \cdot 2$ $\quad A_{s\_prov} = 2.48 \cdot in^2$ — *Steel Supplied per Tendon (4-#5 hat bars distributed between PT and PC)*

$Check1 := if(A_{s\_prov} \geq A_{s\_reqd}, \text{"OK"}, \text{"NG"})$ $\quad Check1 = \text{"OK"}$



T_{burst} = 0.25 ft*(2+30+73+114+126+101+54+13 k/ft) = 128 kips

Loads: BLC 1, PT
Results for LC 1, PT (Service)

FIGG	Canopy End Diaphragm 2&3	SK - 1
ENH		Sept 9, 2016 at 2:47 PM
2262.03		Canopy End Diaphragm 2_3x3_12k6.r3d

Canopy End Diaphragm - Type 2 & 3 - General Zone Reinforcement (12k6 Tendon)

Parameters

$f_{sallDT} := 30 \cdot ksi$ — *Allowable mild steel stress for direct tension per FIGG Design Directive No. 26*

$f_y := 60ksi$ — *Specified yield strength of reinforcement*

Bursting Reinforcement (AASHTO LRFD 5.10.9.6.3)

By inspection, service load case will govern.

$T_{burst} := 128kip$ — $T_{burst} = 128 \cdot kip$ — *See refined RISA-3D analysis for calculation of tensile force ahead of anchorage device*

$A_{sb\_reqd} := \dfrac{T_{burst}}{f_{sallDT}}$ — $A_{sb\_reqd} = 4.27 \cdot in^2$ — *Steel Required per Tendon*

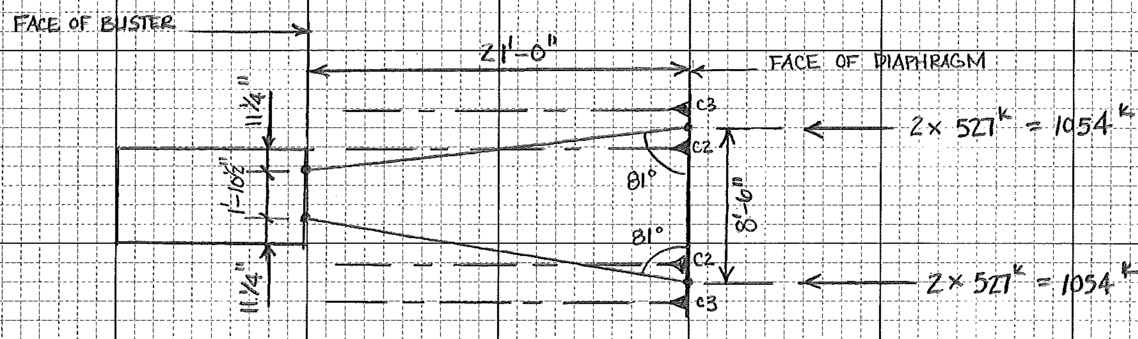
$A_{sb\_prov} := 4 \cdot A_9 + A_5$ — $A_{sb\_prov} = 4.31 \cdot in^2$ — *Steel Supplied per Tendon (4-#9 bars & 1-#5 bar located at exit face of diaphragm)*

$Check2 := if\left(A_{sb\_prov} \geq A_{sb\_reqd}, "OK", "NG"\right)$ — $Check2 = "OK"$

FIGG	Project: FIU PEDESTRIAN BRIDGE	Date: 9/25/16	Page ___ Of ___
	Project Number: 2262.03	Designed: ENH	
	Description: CANOPY END DIAPHRAGM – TYPE II	Checked:	

CHECK TENSILE FORCE BETWEEN TWO GROUPS OF ANCHORAGES

For 12K6 tendon stressed to 75%, $P = 0.75\,(270\text{ ksi})(0.217\text{ in}^2)(12) = 527\text{ kips}$



PLAN

$$F_c = \frac{P}{\sin\alpha} = \frac{1054^k}{\sin 81^\circ} = 1067\text{ kips}$$

$$F_T = F_c\cos\alpha = 1067^k\cos 81^\circ = 167\text{ kips}$$

$$A_s = \frac{F_T}{0.6 f_y} = \frac{167\text{ kips}}{36\text{ ksi}} = \underline{\underline{4.64\text{ in}^2}} \longrightarrow \text{Try } 6-\#8$$

$$A_{s,prov} = 6(0.79\text{ in}^2) = 4.74\text{ in}^2 > 4.64\text{ in}^2 \quad \text{OK}$$

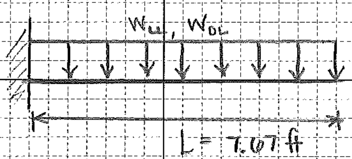
For the Type III Diaphragm, use $\underline{\underline{3-\#8}}$ for one tendon per side (by inspection).

TRANSVERSE DESIGN

Cantilevered Loads:

$W_{LL} = 0.020 \text{ ksf}(3 \text{ ft}) = 0.06 \text{ k/ft}$

$W_{DL} = 8.44 \text{ ft}^2(0.150 \text{ kcf}) = 1.27 \text{ k/ft}$



$M_{LL} = \dfrac{0.06 \text{ k/ft}(7.67 \text{ ft})^2}{2} = 1.76 \text{ k-ft}$

$M_{DL} = \dfrac{1.27 \text{ k/ft}(7.67 \text{ ft})^2}{2} = 37.36 \text{ k-ft}$

$M_u = 1.25 M_{DL} + 1.75 M_{LL} = 50 \text{ k-ft}$

$M_s = 1.00 M_{DL} + 1.00 M_{LL} = 39 \text{ k-ft}$

Design for Canopy Diaphragms 1 + 4 (3'-0" wide) and provide same reinforcement for Canopy Diaphragms 2 + 3 (2'-0" wide).

TEMPERATURE + SHRINKAGE

AASHTO LRFD 5.10.8:

$A_s = \dfrac{1.30 bh}{2(b+h)f_y} = \dfrac{1.30(36 \text{ in})(27 \text{ in})}{2(36 \text{ in} + 27 \text{ in})(60 \text{ ksi})} = 0.17 \dfrac{\text{in}^2}{\text{ft}} \rightarrow$ Use #4 @ 12" min.

$A_{s,prov} = 0.20 \dfrac{\text{in}^2}{\text{ft}} > 0.17 \dfrac{\text{in}^2}{\text{ft}}$ OK

CANOPY END DIAPHRAGM
ULTIMATE MOMENT - CHECK NEGATIVE MOMENT AT ROOT OF CANTILEVER

MATERIAL PROPERTIES

$f_c := 8.5 \cdot ksi$

$f_y := 60 \cdot ksi$

$A'_s := 1 \cdot in^2$

SECTION PROPERTIES

$k := 1000 \cdot lbf$

$h := 27 \cdot in$ — *Height of section*

$b := 36 \cdot in$ — *Width of section*

$d_{bar} := 0.625 \cdot in$ — *Bar diameter (#5)*

$cov := 2.25 \cdot in + 1.128 in$ — *Clear cover*

$c := cov + 0.5 \cdot d_{bar} = 3.69 \cdot in$ — *Cover to center of bar*

$S_x := \frac{b \cdot h^2}{6} = 2.53 \cdot ft^3$ — *Section modulus*

BENDING MOMENTS

$M_{DC} := -37.36 \cdot k \cdot ft$ — *Dead Load Moment*

$M_{LL} := -1.76 \cdot k \cdot ft$ — *Live Load Moment*

$M_{PT} := 0 \cdot k \cdot ft$ — *Assume no PT Moment*

$F_{PRIM} := 0 \cdot k$ (enter positive)

$M_{PRIM} := 0 \cdot k \cdot ft$ (enter positive)

$M_{u1} := 1.25 \cdot M_{DC} + 1.75 \cdot M_{LL} + M_{PT}$ $\quad M_{u1} = -50 \cdot k \cdot ft$ — *Ultimate Design Moment (Strength I)*

$M_{u2} := 0.9 \cdot M_{DC} + 1.75 \cdot M_{LL} + M_{PT}$ $\quad M_{u2} = -37 \cdot k \cdot ft$

$M_u := \max(|M_{u1}|, |M_{u2}|)$ $\quad \boxed{M_u = 50 \cdot k \cdot ft}$

MINIMUM REINFORCEMENT CHECK (AASHTO LRFD 5.7.3.3.2)

$f_r := 0.24 \cdot \sqrt{\frac{f_c}{ksi}} \cdot ksi$ $\quad f_r = 0.700 \cdot ksi$ *Modulus of Rupture*

$f_{cpe} := \frac{F_{PRIM}}{h \cdot b} + \frac{M_{PRIM}}{S_x}$ $\quad f_{cpe} = 0.000 \cdot ksi$ *Compressive stress from PT*

$\gamma_1 := 1.6$ *Flexural cracking variability factor*

$\gamma_2 := 1.1$ *Prestress variability factor*

$\gamma_3 := 0.67$ *Yield/Ultimate ratio factor*

$M_{u3} := 1.33 \cdot M_u$ $\quad M_{u3} = 66 \cdot k \cdot ft$

$M_{u4} := \gamma_3 \cdot (\gamma_1 \cdot f_r + \gamma_2 \cdot f_{cpe}) \cdot S_x$ $\quad M_{u4} = 273 \cdot k \cdot ft$

$M_{u.min} := \max(\min(|M_{u3}|, |M_{u4}|), |M_u|)$ $\quad M_{u.min} = 66 \cdot k \cdot ft$

CHECK1 := | "OK" if $|M_u| \ge |M_{u.min}|$
"DESIGN FOR MIN. REQUIREMENT" otherwise

CHECK1 = "DESIGN FOR MIN. REQUIREMENT"

TRANSVERSE MILD REINFORCEMENT DESIGN (TOP OF SECTION)

$\phi := 0.9$

$d := h - c = 23.31 \cdot in$

$a(A_s) := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$

$\phi M_n(A_s) := \phi \cdot A_s \cdot f_y \cdot \left(d - \frac{a(A_s)}{2}\right)$

$A_s := root\left(M_{u.min} - \phi M_n(A'_s), A'_s, 0.0 \cdot in^2, 10 \cdot in^2\right)$ $\quad A_s = 0.63 \cdot in^2$

Try 4-#5:

$A_{s\_prov} := 4 \cdot 0.31 in^2 = 1.24 \cdot in^2$

CHECK2 := | "OK" if $A_{s\_prov} \ge A_s$
"NG" otherwise

CHECK2 = "OK"

Section III

Pipe Supports

DEFLECTION OF STEEL PIPES (SELFWEIGHT)

Section Properties

d_o (in)	16
t (in)	1.438
d_i (in)	13.124
A (in^2)	65.79
I (in^4)	1760.74
E (ksi)	29000

			Simply Supported	Fixed Support
Steel Pipe	**L (ft)**	**Weight (lb/ft)**	**Deflection (in)**	**Deflection (in)**
1D	38.09	223.85	0.21	0.04
2D	62.69	223.85	1.52	0.30
3D	88.77	223.85	6.13	1.23
4D	115.53	223.85	17.57	3.51
5D	142.67	223.85	40.86	8.17
1U	37.73	223.85	0.20	0.04
2U	50.84	223.85	0.66	0.13
3U	64.10	223.85	1.67	0.33
4U	77.47	223.85	3.55	0.71
5U	90.92	223.85	6.74	1.35

Notes:
1. Steel Pipe 1 - shortest cable, Steel Pipe 5 - longest cable
2. Length of pipes were measured in CADD.
3. Weight given in Saginaw manufacturer dimension charts.

STEEL PIPES

MEMBER STRESSES
EOC

(-) compression

			SELWEIGHT (DC)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	EOC: EOC: Other PT Losses	0.04	21.02	-20.95	-20.95	21.02
501	1	EOC: EOC: Other PT Losses	-0.07	-10.61	10.48	10.48	-10.61
501	2	EOC: EOC: Other PT Losses	-0.17	20.47	-20.82	-20.82	20.47
502	0	EOC: EOC: Other PT Losses	0.13	13.83	-13.57	-13.57	13.83
502	1	EOC: EOC: Other PT Losses	0.04	-6.87	6.94	6.94	-6.87
502	2	EOC: EOC: Other PT Losses	-0.06	13.51	-13.63	-13.63	13.51
503	0	EOC: EOC: Other PT Losses	0.22	8.23	-7.79	-7.79	8.23
503	1	EOC: EOC: Other PT Losses	0.14	-3.91	4.19	4.19	-3.91
503	2	EOC: EOC: Other PT Losses	0.05	7.99	-7.88	-7.88	7.99
504	0	EOC: EOC: Other PT Losses	0.30	4.17	-3.57	-3.57	4.17
504	1	EOC: EOC: Other PT Losses	0.23	-1.74	2.19	2.19	-1.74
504	2	EOC: EOC: Other PT Losses	0.15	3.98	-3.67	-3.67	3.98
505	0	EOC: EOC: Other PT Losses	0.30	1.53	-0.93	-0.93	1.53
505	1	EOC: EOC: Other PT Losses	0.24	-0.39	0.87	0.87	-0.39
505	2	EOC: EOC: Other PT Losses	0.18	1.46	-1.09	-1.09	1.46
601	0	EOC: EOC: Other PT Losses	0.27	7.91	-7.38	-7.38	7.91
601	1	EOC: EOC: Other PT Losses	0.17	-3.57	3.91	3.91	-3.57
601	2	EOC: EOC: Other PT Losses	0.06	7.40	-7.27	-7.27	7.40
602	0	EOC: EOC: Other PT Losses	0.28	5.85	-5.29	-5.29	5.85
602	1	EOC: EOC: Other PT Losses	0.19	-2.51	2.88	2.88	-2.51
602	2	EOC: EOC: Other PT Losses	0.10	5.42	-5.23	-5.23	5.42
603	0	EOC: EOC: Other PT Losses	0.23	4.04	-3.59	-3.59	4.04
603	1	EOC: EOC: Other PT Losses	0.15	-1.69	1.98	1.98	-1.69
603	2	EOC: EOC: Other PT Losses	0.07	3.68	-3.55	-3.55	3.68
604	0	EOC: EOC: Other PT Losses	0.17	2.55	-2.22	-2.22	2.55
604	1	EOC: EOC: Other PT Losses	0.10	-1.05	1.24	1.24	-1.05
604	2	EOC: EOC: Other PT Losses	0.03	2.28	-2.23	-2.23	2.28
605	0	EOC: EOC: Other PT Losses	0.11	1.39	-1.17	-1.17	1.39
605	1	EOC: EOC: Other PT Losses	0.05	-0.56	0.67	0.67	-0.56
605	2	EOC: EOC: Other PT Losses	-0.01	1.21	-1.23	-1.23	1.21

STEEL PIPES

MEMBER STRESSES
EOC

(-) compression

			NONSTRUCTURAL COMPONENTS (DC)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	EOC: EOC: Other PT Losses	0.02	0.05	-0.01	-0.01	0.05
501	1	EOC: EOC: Other PT Losses	0.02	0.02	0.02	0.02	0.02
501	2	EOC: EOC: Other PT Losses	0.02	-0.02	0.05	0.05	-0.02
502	0	EOC: EOC: Other PT Losses	0.10	0.13	0.06	0.06	0.13
502	1	EOC: EOC: Other PT Losses	0.10	0.10	0.09	0.09	0.10
502	2	EOC: EOC: Other PT Losses	0.10	0.07	0.13	0.13	0.07
503	0	EOC: EOC: Other PT Losses	0.14	0.17	0.11	0.11	0.17
503	1	EOC: EOC: Other PT Losses	0.14	0.15	0.13	0.13	0.15
503	2	EOC: EOC: Other PT Losses	0.14	0.12	0.16	0.16	0.12
504	0	EOC: EOC: Other PT Losses	0.17	0.20	0.14	0.14	0.20
504	1	EOC: EOC: Other PT Losses	0.17	0.17	0.16	0.16	0.17
504	2	EOC: EOC: Other PT Losses	0.17	0.15	0.18	0.18	0.15
505	0	EOC: EOC: Other PT Losses	0.19	0.20	0.17	0.17	0.20
505	1	EOC: EOC: Other PT Losses	0.19	0.20	0.18	0.18	0.20
505	2	EOC: EOC: Other PT Losses	0.19	0.20	0.18	0.18	0.20
601	0	EOC: EOC: Other PT Losses	0.08	0.06	0.11	0.11	0.06
601	1	EOC: EOC: Other PT Losses	0.08	0.08	0.09	0.09	0.08
601	2	EOC: EOC: Other PT Losses	0.08	0.10	0.06	0.06	0.10
602	0	EOC: EOC: Other PT Losses	0.11	0.07	0.14	0.14	0.07
602	1	EOC: EOC: Other PT Losses	0.11	0.10	0.11	0.11	0.10
602	2	EOC: EOC: Other PT Losses	0.11	0.13	0.08	0.08	0.13
603	0	EOC: EOC: Other PT Losses	0.13	0.10	0.16	0.16	0.10
603	1	EOC: EOC: Other PT Losses	0.13	0.13	0.13	0.13	0.13
603	2	EOC: EOC: Other PT Losses	0.13	0.15	0.11	0.11	0.15
604	0	EOC: EOC: Other PT Losses	0.15	0.13	0.18	0.18	0.13
604	1	EOC: EOC: Other PT Losses	0.15	0.15	0.15	0.15	0.15
604	2	EOC: EOC: Other PT Losses	0.15	0.18	0.13	0.13	0.18
605	0	EOC: EOC: Other PT Losses	0.13	0.11	0.16	0.16	0.11
605	1	EOC: EOC: Other PT Losses	0.13	0.14	0.13	0.13	0.14
605	2	EOC: EOC: Other PT Losses	0.13	0.17	0.10	0.10	0.17

STEEL PIPES

MEMBER STRESSES
EOC

(-) compression

			CREEP (CR)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	EOC: EOC: Other PT Losses	-0.95	-0.66	-1.24	-1.24	-0.66
501	1	EOC: EOC: Other PT Losses	-0.95	-1.03	-0.86	-0.86	-1.03
501	2	EOC: EOC: Other PT Losses	-0.95	-1.41	-0.48	-0.48	-1.41
502	0	EOC: EOC: Other PT Losses	0.09	0.37	-0.19	-0.19	0.37
502	1	EOC: EOC: Other PT Losses	0.09	0.07	0.11	0.11	0.07
502	2	EOC: EOC: Other PT Losses	0.09	-0.23	0.41	0.41	-0.23
503	0	EOC: EOC: Other PT Losses	0.67	0.93	0.41	0.41	0.93
503	1	EOC: EOC: Other PT Losses	0.67	0.71	0.64	0.64	0.71
503	2	EOC: EOC: Other PT Losses	0.67	0.48	0.86	0.86	0.48
504	0	EOC: EOC: Other PT Losses	1.01	1.27	0.74	0.74	1.27
504	1	EOC: EOC: Other PT Losses	1.01	1.06	0.95	0.95	1.06
504	2	EOC: EOC: Other PT Losses	1.01	0.86	1.15	1.15	0.86
505	0	EOC: EOC: Other PT Losses	1.32	1.46	1.18	1.18	1.46
505	1	EOC: EOC: Other PT Losses	1.32	1.44	1.20	1.20	1.44
505	2	EOC: EOC: Other PT Losses	1.32	1.42	1.21	1.22	1.42
601	0	EOC: EOC: Other PT Losses	-0.83	-0.62	-1.03	-1.03	-0.62
601	1	EOC: EOC: Other PT Losses	-0.83	-0.88	-0.77	-0.78	-0.88
601	2	EOC: EOC: Other PT Losses	-0.83	-1.14	-0.51	-0.52	-1.14
602	0	EOC: EOC: Other PT Losses	0.02	0.18	-0.15	-0.15	0.18
602	1	EOC: EOC: Other PT Losses	0.02	-0.02	0.06	0.06	-0.02
602	2	EOC: EOC: Other PT Losses	0.02	-0.22	0.26	0.26	-0.22
603	0	EOC: EOC: Other PT Losses	0.66	0.77	0.56	0.56	0.77
603	1	EOC: EOC: Other PT Losses	0.66	0.65	0.68	0.68	0.65
603	2	EOC: EOC: Other PT Losses	0.66	0.54	0.79	0.79	0.54
604	0	EOC: EOC: Other PT Losses	1.15	1.18	1.11	1.11	1.18
604	1	EOC: EOC: Other PT Losses	1.15	1.17	1.12	1.12	1.17
604	2	EOC: EOC: Other PT Losses	1.15	1.17	1.13	1.13	1.17
605	0	EOC: EOC: Other PT Losses	1.13	1.09	1.16	1.16	1.09
605	1	EOC: EOC: Other PT Losses	1.13	1.18	1.07	1.07	1.18
605	2	EOC: EOC: Other PT Losses	1.13	1.27	0.98	0.98	1.27

STEEL PIPES

MEMBER STRESSES
EOC

(-) compression

			SHRINKAGE (SH)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	EOC: EOC: Other PT Losses	-0.53	-0.50	-0.56	-0.56	-0.50
501	1	EOC: EOC: Other PT Losses	-0.53	-0.53	-0.52	-0.52	-0.53
501	2	EOC: EOC: Other PT Losses	-0.53	-0.57	-0.49	-0.49	-0.57
502	0	EOC: EOC: Other PT Losses	-0.34	-0.30	-0.37	-0.37	-0.30
502	1	EOC: EOC: Other PT Losses	-0.34	-0.33	-0.34	-0.34	-0.33
502	2	EOC: EOC: Other PT Losses	-0.34	-0.37	-0.31	-0.31	-0.37
503	0	EOC: EOC: Other PT Losses	-0.17	-0.14	-0.20	-0.20	-0.14
503	1	EOC: EOC: Other PT Losses	-0.17	-0.17	-0.18	-0.18	-0.17
503	2	EOC: EOC: Other PT Losses	-0.17	-0.19	-0.16	-0.16	-0.19
504	0	EOC: EOC: Other PT Losses	0.01	0.05	-0.04	-0.04	0.05
504	1	EOC: EOC: Other PT Losses	0.01	0.02	0.00	0.00	0.02
504	2	EOC: EOC: Other PT Losses	0.01	-0.02	0.03	0.03	-0.02
505	0	EOC: EOC: Other PT Losses	0.21	0.24	0.18	0.18	0.24
505	1	EOC: EOC: Other PT Losses	0.21	0.23	0.19	0.19	0.23
505	2	EOC: EOC: Other PT Losses	0.21	0.23	0.19	0.19	0.23
601	0	EOC: EOC: Other PT Losses	-0.62	-0.56	-0.69	-0.69	-0.56
601	1	EOC: EOC: Other PT Losses	-0.62	-0.63	-0.61	-0.61	-0.63
601	2	EOC: EOC: Other PT Losses	-0.62	-0.71	-0.53	-0.53	-0.71
602	0	EOC: EOC: Other PT Losses	-0.38	-0.32	-0.45	-0.45	-0.32
602	1	EOC: EOC: Other PT Losses	-0.38	-0.39	-0.38	-0.38	-0.39
602	2	EOC: EOC: Other PT Losses	-0.38	-0.46	-0.31	-0.31	-0.46
603	0	EOC: EOC: Other PT Losses	-0.19	-0.13	-0.26	-0.26	-0.13
603	1	EOC: EOC: Other PT Losses	-0.19	-0.19	-0.20	-0.20	-0.19
603	2	EOC: EOC: Other PT Losses	-0.19	-0.25	-0.13	-0.13	-0.25
604	0	EOC: EOC: Other PT Losses	-0.01	0.07	-0.08	-0.08	0.07
604	1	EOC: EOC: Other PT Losses	-0.01	0.00	-0.01	-0.01	0.00
604	2	EOC: EOC: Other PT Losses	-0.01	-0.07	0.06	0.06	-0.07
605	0	EOC: EOC: Other PT Losses	0.25	0.31	0.19	0.19	0.31
605	1	EOC: EOC: Other PT Losses	0.25	0.27	0.23	0.23	0.27
605	2	EOC: EOC: Other PT Losses	0.25	0.23	0.27	0.27	0.23

STEEL PIPES

MEMBER STRESSES
EOC

(-) compression

			UTILITIES (DW)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	EOC: EOC: Other PT Losses	0.04	0.10	-0.02	-0.02	0.10
501	1	EOC: EOC: Other PT Losses	0.04	0.03	0.04	0.04	0.03
501	2	EOC: EOC: Other PT Losses	0.04	-0.03	0.10	0.10	-0.03
502	0	EOC: EOC: Other PT Losses	0.18	0.25	0.12	0.12	0.25
502	1	EOC: EOC: Other PT Losses	0.18	0.19	0.18	0.18	0.19
502	2	EOC: EOC: Other PT Losses	0.18	0.13	0.24	0.24	0.13
503	0	EOC: EOC: Other PT Losses	0.26	0.32	0.20	0.20	0.32
503	1	EOC: EOC: Other PT Losses	0.26	0.27	0.25	0.25	0.27
503	2	EOC: EOC: Other PT Losses	0.26	0.23	0.30	0.30	0.23
504	0	EOC: EOC: Other PT Losses	0.31	0.37	0.26	0.26	0.37
504	1	EOC: EOC: Other PT Losses	0.31	0.32	0.30	0.30	0.32
504	2	EOC: EOC: Other PT Losses	0.31	0.28	0.34	0.34	0.28
505	0	EOC: EOC: Other PT Losses	0.35	0.37	0.33	0.33	0.37
505	1	EOC: EOC: Other PT Losses	0.35	0.37	0.33	0.33	0.37
505	2	EOC: EOC: Other PT Losses	0.35	0.37	0.34	0.34	0.37
601	0	EOC: EOC: Other PT Losses	0.15	0.11	0.20	0.20	0.11
601	1	EOC: EOC: Other PT Losses	0.15	0.15	0.16	0.16	0.15
601	2	EOC: EOC: Other PT Losses	0.15	0.19	0.12	0.12	0.19
602	0	EOC: EOC: Other PT Losses	0.21	0.15	0.26	0.26	0.15
602	1	EOC: EOC: Other PT Losses	0.21	0.20	0.21	0.21	0.20
602	2	EOC: EOC: Other PT Losses	0.21	0.25	0.16	0.16	0.25
603	0	EOC: EOC: Other PT Losses	0.25	0.20	0.30	0.30	0.20
603	1	EOC: EOC: Other PT Losses	0.25	0.24	0.25	0.25	0.24
603	2	EOC: EOC: Other PT Losses	0.25	0.29	0.21	0.21	0.29
604	0	EOC: EOC: Other PT Losses	0.29	0.24	0.33	0.33	0.24
604	1	EOC: EOC: Other PT Losses	0.29	0.29	0.29	0.29	0.29
604	2	EOC: EOC: Other PT Losses	0.29	0.33	0.24	0.24	0.33
605	0	EOC: EOC: Other PT Losses	0.25	0.21	0.30	0.30	0.21
605	1	EOC: EOC: Other PT Losses	0.25	0.26	0.25	0.25	0.26
605	2	EOC: EOC: Other PT Losses	0.25	0.32	0.19	0.19	0.32

STEEL PIPES

MEMBER STRESSES
EOC

(-) compression

			LIVE LOAD ON FULL LENGTH OF BRIDGE (LL1)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	EOC: EOC: Other PT Losses	0.13	0.35	-0.09	-0.09	0.35
501	1	EOC: EOC: Other PT Losses	0.13	0.12	0.14	0.14	0.12
501	2	EOC: EOC: Other PT Losses	0.13	-0.11	0.37	0.37	-0.11
502	0	EOC: EOC: Other PT Losses	0.67	0.91	0.43	0.43	0.91
502	1	EOC: EOC: Other PT Losses	0.67	0.69	0.66	0.66	0.69
502	2	EOC: EOC: Other PT Losses	0.67	0.46	0.88	0.88	0.46
503	0	EOC: EOC: Other PT Losses	0.96	1.18	0.75	0.75	1.18
503	1	EOC: EOC: Other PT Losses	0.96	1.01	0.92	0.92	1.01
503	2	EOC: EOC: Other PT Losses	0.96	0.83	1.09	1.09	0.83
504	0	EOC: EOC: Other PT Losses	1.14	1.34	0.94	0.94	1.34
504	1	EOC: EOC: Other PT Losses	1.14	1.18	1.10	1.10	1.18
504	2	EOC: EOC: Other PT Losses	1.14	1.03	1.25	1.25	1.03
505	0	EOC: EOC: Other PT Losses	1.28	1.37	1.19	1.19	1.37
505	1	EOC: EOC: Other PT Losses	1.28	1.35	1.21	1.21	1.35
505	2	EOC: EOC: Other PT Losses	1.28	1.34	1.23	1.23	1.34
601	0	EOC: EOC: Other PT Losses	0.56	0.39	0.74	0.73	0.39
601	1	EOC: EOC: Other PT Losses	0.56	0.54	0.59	0.59	0.54
601	2	EOC: EOC: Other PT Losses	0.56	0.68	0.45	0.45	0.68
602	0	EOC: EOC: Other PT Losses	0.75	0.55	0.95	0.95	0.55
602	1	EOC: EOC: Other PT Losses	0.75	0.73	0.77	0.77	0.73
602	2	EOC: EOC: Other PT Losses	0.75	0.91	0.59	0.59	0.91
603	0	EOC: EOC: Other PT Losses	0.91	0.72	1.10	1.10	0.72
603	1	EOC: EOC: Other PT Losses	0.91	0.89	0.93	0.93	0.89
603	2	EOC: EOC: Other PT Losses	0.91	1.07	0.76	0.76	1.07
604	0	EOC: EOC: Other PT Losses	1.06	0.89	1.22	1.22	0.89
604	1	EOC: EOC: Other PT Losses	1.06	1.06	1.06	1.06	1.06
604	2	EOC: EOC: Other PT Losses	1.06	1.22	0.89	0.89	1.22
605	0	EOC: EOC: Other PT Losses	0.93	0.77	1.09	1.09	0.77
605	1	EOC: EOC: Other PT Losses	0.93	0.96	0.90	0.90	0.96
605	2	EOC: EOC: Other PT Losses	0.93	1.16	0.71	0.71	1.16

STEEL PIPES

MEMBER STRESSES
EOC

(-) compression

			LIVE LOAD ON MAIN SPAN (LL2)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	EOC: EOC: Other PT Losses	-0.06	0.23	-0.35	-0.35	0.23
501	1	EOC: EOC: Other PT Losses	-0.06	-0.06	-0.05	-0.05	-0.06
501	2	EOC: EOC: Other PT Losses	-0.06	-0.36	0.24	0.24	-0.36
502	0	EOC: EOC: Other PT Losses	0.48	0.81	0.16	0.16	0.81
502	1	EOC: EOC: Other PT Losses	0.48	0.51	0.46	0.46	0.51
502	2	EOC: EOC: Other PT Losses	0.48	0.20	0.76	0.76	0.20
503	0	EOC: EOC: Other PT Losses	0.75	1.06	0.45	0.45	1.06
503	1	EOC: EOC: Other PT Losses	0.75	0.81	0.70	0.70	0.81
503	2	EOC: EOC: Other PT Losses	0.75	0.55	0.96	0.96	0.55
504	0	EOC: EOC: Other PT Losses	0.93	1.22	0.64	0.64	1.22
504	1	EOC: EOC: Other PT Losses	0.93	0.98	0.88	0.88	0.98
504	2	EOC: EOC: Other PT Losses	0.93	0.75	1.11	1.11	0.75
505	0	EOC: EOC: Other PT Losses	1.18	1.34	1.02	1.02	1.34
505	1	EOC: EOC: Other PT Losses	1.18	1.26	1.11	1.11	1.26
505	2	EOC: EOC: Other PT Losses	1.18	1.17	1.19	1.19	1.17
601	0	EOC: EOC: Other PT Losses	0.54	0.23	0.85	0.85	0.23
601	1	EOC: EOC: Other PT Losses	0.54	0.51	0.57	0.57	0.51
601	2	EOC: EOC: Other PT Losses	0.54	0.79	0.28	0.29	0.79
602	0	EOC: EOC: Other PT Losses	0.57	0.19	0.94	0.94	0.19
602	1	EOC: EOC: Other PT Losses	0.57	0.54	0.59	0.60	0.54
602	2	EOC: EOC: Other PT Losses	0.57	0.88	0.25	0.25	0.88
603	0	EOC: EOC: Other PT Losses	0.61	0.25	0.98	0.98	0.25
603	1	EOC: EOC: Other PT Losses	0.61	0.58	0.65	0.65	0.58
603	2	EOC: EOC: Other PT Losses	0.61	0.91	0.31	0.31	0.92
604	0	EOC: EOC: Other PT Losses	0.63	0.32	0.94	0.94	0.32
604	1	EOC: EOC: Other PT Losses	0.63	0.61	0.65	0.65	0.61
604	2	EOC: EOC: Other PT Losses	0.63	0.90	0.36	0.36	0.90
605	0	EOC: EOC: Other PT Losses	0.53	0.31	0.74	0.74	0.31
605	1	EOC: EOC: Other PT Losses	0.53	0.52	0.53	0.53	0.52
605	2	EOC: EOC: Other PT Losses	0.53	0.74	0.31	0.31	0.74

STEEL PIPES

MEMBER STRESSES
EOC

(-) compression

			LIVE LOAD ON BACK SPAN (LL3)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	EOC: EOC: Other PT Losses	0.19	0.12	0.26	0.26	0.12
501	1	EOC: EOC: Other PT Losses	0.19	0.18	0.20	0.20	0.19
501	2	EOC: EOC: Other PT Losses	0.19	0.25	0.13	0.13	0.25
502	0	EOC: EOC: Other PT Losses	0.19	0.10	0.28	0.28	0.10
502	1	EOC: EOC: Other PT Losses	0.19	0.18	0.20	0.20	0.18
502	2	EOC: EOC: Other PT Losses	0.19	0.26	0.12	0.12	0.26
503	0	EOC: EOC: Other PT Losses	0.21	0.11	0.30	0.30	0.11
503	1	EOC: EOC: Other PT Losses	0.21	0.20	0.22	0.22	0.20
503	2	EOC: EOC: Other PT Losses	0.21	0.28	0.13	0.13	0.28
504	0	EOC: EOC: Other PT Losses	0.21	0.13	0.30	0.30	0.13
504	1	EOC: EOC: Other PT Losses	0.21	0.20	0.22	0.22	0.20
504	2	EOC: EOC: Other PT Losses	0.21	0.28	0.14	0.14	0.28
505	0	EOC: EOC: Other PT Losses	0.10	0.03	0.17	0.17	0.03
505	1	EOC: EOC: Other PT Losses	0.10	0.10	0.10	0.10	0.10
505	2	EOC: EOC: Other PT Losses	0.10	0.16	0.04	0.04	0.16
601	0	EOC: EOC: Other PT Losses	0.03	0.17	-0.12	-0.12	0.17
601	1	EOC: EOC: Other PT Losses	0.03	0.03	0.02	0.02	0.03
601	2	EOC: EOC: Other PT Losses	0.03	-0.11	0.16	0.16	-0.11
602	0	EOC: EOC: Other PT Losses	0.18	0.36	0.01	0.01	0.36
602	1	EOC: EOC: Other PT Losses	0.18	0.19	0.18	0.18	0.19
602	2	EOC: EOC: Other PT Losses	0.18	0.03	0.34	0.34	0.03
603	0	EOC: EOC: Other PT Losses	0.30	0.47	0.13	0.13	0.47
603	1	EOC: EOC: Other PT Losses	0.30	0.31	0.28	0.28	0.31
603	2	EOC: EOC: Other PT Losses	0.30	0.15	0.44	0.44	0.15
604	0	EOC: EOC: Other PT Losses	0.43	0.57	0.28	0.28	0.57
604	1	EOC: EOC: Other PT Losses	0.43	0.44	0.41	0.41	0.44
604	2	EOC: EOC: Other PT Losses	0.43	0.32	0.53	0.53	0.32
605	0	EOC: EOC: Other PT Losses	0.41	0.46	0.35	0.35	0.46
605	1	EOC: EOC: Other PT Losses	0.41	0.44	0.37	0.37	0.44
605	2	EOC: EOC: Other PT Losses	0.41	0.42	0.40	0.40	0.42

STEEL PIPES

MEMBER STRESSES
EOC

(-) compression

			TEMPERATURE RISE (TU+)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	EOC: EOC: Other PT Losses	-1.03	-1.02	-1.03	-1.03	-1.02
501	1	EOC: EOC: Other PT Losses	-1.03	-1.05	-1.00	-1.00	-1.05
501	2	EOC: EOC: Other PT Losses	-1.03	-1.07	-0.98	-0.98	-1.07
502	0	EOC: EOC: Other PT Losses	-0.51	-0.50	-0.52	-0.52	-0.50
502	1	EOC: EOC: Other PT Losses	-0.51	-0.52	-0.50	-0.50	-0.52
502	2	EOC: EOC: Other PT Losses	-0.51	-0.54	-0.47	-0.47	-0.54
503	0	EOC: EOC: Other PT Losses	0.02	0.01	0.03	0.03	0.01
503	1	EOC: EOC: Other PT Losses	0.02	0.02	0.02	0.02	0.02
503	2	EOC: EOC: Other PT Losses	0.02	0.04	0.00	0.00	0.04
504	0	EOC: EOC: Other PT Losses	0.63	0.64	0.63	0.63	0.64
504	1	EOC: EOC: Other PT Losses	0.63	0.64	0.63	0.63	0.64
504	2	EOC: EOC: Other PT Losses	0.63	0.63	0.64	0.64	0.63
505	0	EOC: EOC: Other PT Losses	0.56	0.38	0.75	0.75	0.38
505	1	EOC: EOC: Other PT Losses	0.56	0.65	0.48	0.48	0.65
505	2	EOC: EOC: Other PT Losses	0.56	0.93	0.20	0.20	0.93
601	0	EOC: EOC: Other PT Losses	-1.08	-1.10	-1.06	-1.06	-1.10
601	1	EOC: EOC: Other PT Losses	-1.08	-1.11	-1.05	-1.05	-1.11
601	2	EOC: EOC: Other PT Losses	-1.08	-1.12	-1.04	-1.04	-1.12
602	0	EOC: EOC: Other PT Losses	-0.60	-0.61	-0.58	-0.58	-0.61
602	1	EOC: EOC: Other PT Losses	-0.60	-0.62	-0.58	-0.58	-0.62
602	2	EOC: EOC: Other PT Losses	-0.60	-0.62	-0.58	-0.58	-0.62
603	0	EOC: EOC: Other PT Losses	-0.14	-0.15	-0.14	-0.14	-0.15
603	1	EOC: EOC: Other PT Losses	-0.14	-0.14	-0.14	-0.14	-0.14
603	2	EOC: EOC: Other PT Losses	-0.14	-0.14	-0.14	-0.14	-0.14
604	0	EOC: EOC: Other PT Losses	0.33	0.40	0.27	0.27	0.40
604	1	EOC: EOC: Other PT Losses	0.33	0.33	0.34	0.34	0.33
604	2	EOC: EOC: Other PT Losses	0.33	0.26	0.41	0.41	0.26
605	0	EOC: EOC: Other PT Losses	1.13	1.11	1.15	1.15	1.11
605	1	EOC: EOC: Other PT Losses	1.13	1.21	1.05	1.05	1.21
605	2	EOC: EOC: Other PT Losses	1.13	1.31	0.95	0.95	1.31

STEEL PIPES

MEMBER STRESSES
EOC

(-) compression

			TEMPERATURE FALL (TU-)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	EOC: EOC: Other PT Losses	1.03	1.02	1.03	1.03	1.02
501	1	EOC: EOC: Other PT Losses	1.03	1.05	1.00	1.00	1.05
501	2	EOC: EOC: Other PT Losses	1.03	1.07	0.98	0.98	1.07
502	0	EOC: EOC: Other PT Losses	0.51	0.50	0.52	0.52	0.50
502	1	EOC: EOC: Other PT Losses	0.51	0.52	0.50	0.50	0.52
502	2	EOC: EOC: Other PT Losses	0.51	0.54	0.47	0.47	0.54
503	0	EOC: EOC: Other PT Losses	-0.02	-0.01	-0.03	-0.03	-0.01
503	1	EOC: EOC: Other PT Losses	-0.02	-0.02	-0.02	-0.02	-0.02
503	2	EOC: EOC: Other PT Losses	-0.02	-0.04	0.00	0.00	-0.04
504	0	EOC: EOC: Other PT Losses	-0.63	-0.64	-0.63	-0.63	-0.64
504	1	EOC: EOC: Other PT Losses	-0.63	-0.64	-0.63	-0.63	-0.64
504	2	EOC: EOC: Other PT Losses	-0.63	-0.63	-0.64	-0.64	-0.63
505	0	EOC: EOC: Other PT Losses	-0.56	-0.38	-0.75	-0.75	-0.38
505	1	EOC: EOC: Other PT Losses	-0.56	-0.65	-0.48	-0.48	-0.65
505	2	EOC: EOC: Other PT Losses	-0.56	-0.93	-0.20	-0.20	-0.93
601	0	EOC: EOC: Other PT Losses	1.08	1.10	1.06	1.06	1.10
601	1	EOC: EOC: Other PT Losses	1.08	1.11	1.05	1.05	1.11
601	2	EOC: EOC: Other PT Losses	1.08	1.12	1.04	1.04	1.12
602	0	EOC: EOC: Other PT Losses	0.60	0.61	0.58	0.58	0.61
602	1	EOC: EOC: Other PT Losses	0.60	0.62	0.58	0.58	0.62
602	2	EOC: EOC: Other PT Losses	0.60	0.62	0.58	0.58	0.62
603	0	EOC: EOC: Other PT Losses	0.14	0.15	0.14	0.14	0.15
603	1	EOC: EOC: Other PT Losses	0.14	0.14	0.14	0.14	0.14
603	2	EOC: EOC: Other PT Losses	0.14	0.14	0.14	0.14	0.14
604	0	EOC: EOC: Other PT Losses	-0.33	-0.40	-0.27	-0.27	-0.40
604	1	EOC: EOC: Other PT Losses	-0.33	-0.33	-0.34	-0.34	-0.33
604	2	EOC: EOC: Other PT Losses	-0.33	-0.26	-0.41	-0.41	-0.26
605	0	EOC: EOC: Other PT Losses	-1.13	-1.11	-1.15	-1.15	-1.11
605	1	EOC: EOC: Other PT Losses	-1.13	-1.21	-1.05	-1.05	-1.21
605	2	EOC: EOC: Other PT Losses	-1.13	-1.31	-0.95	-0.95	-1.31

STEEL PIPES

MEMBER STRESSES
EOC

(-) compression

			TEMP. RISE + TEMP. DIFF. (TU+ + TEMP. DIFF.)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	EOC: EOC: Other PT Losses	-2.57	-2.48	-2.66	-2.66	-2.48
501	1	EOC: EOC: Other PT Losses	-2.57	-2.60	-2.55	-2.55	-2.60
501	2	EOC: EOC: Other PT Losses	-2.57	-2.72	-2.43	-2.43	-2.72
502	0	EOC: EOC: Other PT Losses	-1.60	-1.49	-1.71	-1.71	-1.49
502	1	EOC: EOC: Other PT Losses	-1.60	-1.60	-1.59	-1.59	-1.60
502	2	EOC: EOC: Other PT Losses	-1.60	-1.71	-1.48	-1.48	-1.71
503	0	EOC: EOC: Other PT Losses	-0.70	-0.61	-0.80	-0.80	-0.61
503	1	EOC: EOC: Other PT Losses	-0.70	-0.67	-0.73	-0.73	-0.67
503	2	EOC: EOC: Other PT Losses	-0.70	-0.74	-0.66	-0.66	-0.74
504	0	EOC: EOC: Other PT Losses	0.25	0.38	0.12	0.12	0.38
504	1	EOC: EOC: Other PT Losses	0.25	0.29	0.21	0.21	0.29
504	2	EOC: EOC: Other PT Losses	0.25	0.20	0.31	0.31	0.20
505	0	EOC: EOC: Other PT Losses	0.47	0.35	0.59	0.59	0.35
505	1	EOC: EOC: Other PT Losses	0.47	0.63	0.31	0.31	0.63
505	2	EOC: EOC: Other PT Losses	0.47	0.91	0.03	0.03	0.91
601	0	EOC: EOC: Other PT Losses	-2.89	-2.84	-2.95	-2.95	-2.84
601	1	EOC: EOC: Other PT Losses	-2.89	-2.95	-2.83	-2.83	-2.95
601	2	EOC: EOC: Other PT Losses	-2.89	-3.07	-2.71	-2.71	-3.07
602	0	EOC: EOC: Other PT Losses	-1.82	-1.76	-1.88	-1.88	-1.76
602	1	EOC: EOC: Other PT Losses	-1.82	-1.86	-1.78	-1.78	-1.86
602	2	EOC: EOC: Other PT Losses	-1.82	-1.96	-1.68	-1.68	-1.96
603	0	EOC: EOC: Other PT Losses	-0.92	-0.88	-0.97	-0.97	-0.88
603	1	EOC: EOC: Other PT Losses	-0.92	-0.92	-0.92	-0.92	-0.92
603	2	EOC: EOC: Other PT Losses	-0.92	-0.97	-0.87	-0.87	-0.97
604	0	EOC: EOC: Other PT Losses	-0.12	-0.01	-0.23	-0.23	-0.01
604	1	EOC: EOC: Other PT Losses	-0.12	-0.11	-0.12	-0.12	-0.11
604	2	EOC: EOC: Other PT Losses	-0.12	-0.22	-0.02	-0.02	-0.22
605	0	EOC: EOC: Other PT Losses	0.94	0.91	0.98	0.98	0.91
605	1	EOC: EOC: Other PT Losses	0.94	1.07	0.82	0.82	1.07
605	2	EOC: EOC: Other PT Losses	0.94	1.23	0.66	0.66	1.23

STEEL PIPES

MEMBER STRESSES
EOC

fy (ksi) 46

(-) compression $\sigma_{allow} = 0.6*fy =$ **27.6 ksi**

			SERVICE II-CASE A (LL ON FULL LENGTH OF BRIDGE)				
Member	Station	Result Case	(P/A) @ Centroid (ksi)	Normal Stress @ Point 1 (ksi)	Normal Stress @ Point 2 (ksi)	Normal Stress @ Point 3 (ksi)	Normal Stress @ Point 4 (ksi)
501	0	EOC: EOC: Other PT Losses	0	21	-22	-22	21
501	1	EOC: EOC: Other PT Losses	0	-11	10	10	-11
501	2	EOC: EOC: Other PT Losses	0	19	-20	-20	19
502	0	EOC: EOC: Other PT Losses	2	16	-13	-13	16
502	1	EOC: EOC: Other PT Losses	1	-5	8	8	-5
502	2	EOC: EOC: Other PT Losses	1	14	-12	-12	14
503	0	EOC: EOC: Other PT Losses	2	11	-6	-6	11
503	1	EOC: EOC: Other PT Losses	2	-2	6	6	-2
503	2	EOC: EOC: Other PT Losses	2	10	-5	-5	10
504	0	EOC: EOC: Other PT Losses	4	8	-1	-1	8
504	1	EOC: EOC: Other PT Losses	4	2	6	6	2
504	2	EOC: EOC: Other PT Losses	4	7	0	0	7
505	0	EOC: EOC: Other PT Losses	5	6	3	3	6
505	1	EOC: EOC: Other PT Losses	5	4	5	5	4
505	2	EOC: EOC: Other PT Losses	4	6	3	3	6
601	0	EOC: EOC: Other PT Losses	1	9	-7	-7	9
601	1	EOC: EOC: Other PT Losses	1	-3	5	5	-3
601	2	EOC: EOC: Other PT Losses	1	8	-7	-7	8
602	0	EOC: EOC: Other PT Losses	2	7	-4	-4	7
602	1	EOC: EOC: Other PT Losses	2	-1	4	4	-1
602	2	EOC: EOC: Other PT Losses	2	7	-4	-4	7
603	0	EOC: EOC: Other PT Losses	2	6	-1	-1	6
603	1	EOC: EOC: Other PT Losses	2	0	4	4	0
603	2	EOC: EOC: Other PT Losses	2	6	-1	-1	6
604	0	EOC: EOC: Other PT Losses	3	6	1	1	6
604	1	EOC: EOC: Other PT Losses	3	2	5	5	2
604	2	EOC: EOC: Other PT Losses	3	6	1	1	6
605	0	EOC: EOC: Other PT Losses	4	5	3	3	5
605	1	EOC: EOC: Other PT Losses	4	4	5	5	4
605	2	EOC: EOC: Other PT Losses	4	6	2	2	6

STEEL PIPES

MEMBER STRESSES
EOC

fy (ksi) 46

(-) compression $\sigma_{allow} = 0.6*fy =$ **27.6 ksi**

			SERVICE II-CASE B (LL ONLY ON MAIN SPAN)				
Member	Station	Result Case	(P/A) @ Centroid (ksi)	Normal Stress @ Point 1 (ksi)	Normal Stress @ Point 2 (ksi)	Normal Stress @ Point 3 (ksi)	Normal Stress @ Point 4 (ksi)
501	0	EOC: EOC: Other PT Losses	0	21	-22	-22	21
501	1	EOC: EOC: Other PT Losses	-1	-11	10	10	-11
501	2	EOC: EOC: Other PT Losses	-1	19	-20	-20	19
502	0	EOC: EOC: Other PT Losses	1	16	-13	-13	16
502	1	EOC: EOC: Other PT Losses	1	-6	8	8	-6
502	2	EOC: EOC: Other PT Losses	1	14	-12	-12	14
503	0	EOC: EOC: Other PT Losses	2	11	-7	-7	11
503	1	EOC: EOC: Other PT Losses	2	-2	6	6	-2
503	2	EOC: EOC: Other PT Losses	2	9	-5	-5	9
504	0	EOC: EOC: Other PT Losses	4	8	-1	-1	8
504	1	EOC: EOC: Other PT Losses	4	2	5	5	2
504	2	EOC: EOC: Other PT Losses	3	7	0	0	7
505	0	EOC: EOC: Other PT Losses	4	6	3	3	6
505	1	EOC: EOC: Other PT Losses	4	4	5	5	4
505	2	EOC: EOC: Other PT Losses	4	6	3	3	6
601	0	EOC: EOC: Other PT Losses	1	8	-7	-7	8
601	1	EOC: EOC: Other PT Losses	1	-3	5	5	-3
601	2	EOC: EOC: Other PT Losses	1	8	-7	-7	8
602	0	EOC: EOC: Other PT Losses	2	7	-4	-4	7
602	1	EOC: EOC: Other PT Losses	1	-1	4	4	-1
602	2	EOC: EOC: Other PT Losses	1	7	-4	-4	7
603	0	EOC: EOC: Other PT Losses	2	5	-1	-1	5
603	1	EOC: EOC: Other PT Losses	2	0	4	4	0
603	2	EOC: EOC: Other PT Losses	2	6	-2	-2	6
604	0	EOC: EOC: Other PT Losses	3	5	1	1	5
604	1	EOC: EOC: Other PT Losses	3	2	4	4	2
604	2	EOC: EOC: Other PT Losses	3	5	0	0	5
605	0	EOC: EOC: Other PT Losses	4	5	3	3	5
605	1	EOC: EOC: Other PT Losses	4	3	4	4	3
605	2	EOC: EOC: Other PT Losses	4	5	2	2	5

STEEL PIPES

MEMBER STRESSES
EOC

fy (ksi) 46

(-) compression $\sigma_{allow} = 0.6*fy =$ **27.6 ksi**

			SERVICE II-CASE C (LL ONLY ON BACK SPAN)					CHECK
Member	Station	Result Case	(P/A) @ Centroid (ksi)	Normal Stress @ Point 1 (ksi)	Normal Stress @ Point 2 (ksi)	Normal Stress @ Point 3 (ksi)	Normal Stress @ Point 4 (ksi)	$\sigma_u <= \sigma_{allow}$
501	0	EOC: EOC: Other PT Losses	0	21	-21	-21	21	OK
501	1	EOC: EOC: Other PT Losses	0	-11	10	10	-11	OK
501	2	EOC: EOC: Other PT Losses	0	20	-20	-20	20	OK
502	0	EOC: EOC: Other PT Losses	1	15	-13	-13	15	OK
502	1	EOC: EOC: Other PT Losses	1	-6	8	8	-6	OK
502	2	EOC: EOC: Other PT Losses	1	14	-13	-13	14	OK
503	0	EOC: EOC: Other PT Losses	1	10	-7	-7	10	OK
503	1	EOC: EOC: Other PT Losses	1	-3	5	5	-3	OK
503	2	EOC: EOC: Other PT Losses	1	9	-7	-7	9	OK
504	0	EOC: EOC: Other PT Losses	3	7	-1	-1	7	OK
504	1	EOC: EOC: Other PT Losses	3	1	5	5	1	OK
504	2	EOC: EOC: Other PT Losses	3	6	-1	-1	6	OK
505	0	EOC: EOC: Other PT Losses	3	4	2	2	4	OK
505	1	EOC: EOC: Other PT Losses	3	3	3	3	3	OK
505	2	EOC: EOC: Other PT Losses	3	5	1	1	5	OK
601	0	EOC: EOC: Other PT Losses	0	8	-8	-8	8	OK
601	1	EOC: EOC: Other PT Losses	0	-4	4	4	-4	OK
601	2	EOC: EOC: Other PT Losses	0	7	-7	-7	7	OK
602	0	EOC: EOC: Other PT Losses	1	7	-5	-5	7	OK
602	1	EOC: EOC: Other PT Losses	1	-2	4	4	-2	OK
602	2	EOC: EOC: Other PT Losses	1	6	-4	-4	6	OK
603	0	EOC: EOC: Other PT Losses	2	6	-3	-3	6	OK
603	1	EOC: EOC: Other PT Losses	2	0	3	3	0	OK
603	2	EOC: EOC: Other PT Losses	1	5	-2	-2	5	OK
604	0	EOC: EOC: Other PT Losses	3	5	0	0	5	OK
604	1	EOC: EOC: Other PT Losses	3	1	4	4	1	OK
604	2	EOC: EOC: Other PT Losses	2	5	0	0	5	OK
605	0	EOC: EOC: Other PT Losses	4	5	2	2	5	OK
605	1	EOC: EOC: Other PT Losses	3	3	4	4	3	OK
605	2	EOC: EOC: Other PT Losses	3	5	2	2	5	OK

STEEL PIPES

MEMBER STRESSES
D10K

(-) compression

			SELWEIGHT (DC)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	D10K: D10K: Other PT Losses	0.04	21.02	-20.95	-20.95	21.02
501	1	D10K: D10K: Other PT Losses	-0.07	-10.61	10.48	10.48	-10.61
501	2	D10K: D10K: Other PT Losses	-0.17	20.47	-20.82	-20.82	20.47
502	0	D10K: D10K: Other PT Losses	0.13	13.83	-13.57	-13.57	13.83
502	1	D10K: D10K: Other PT Losses	0.04	-6.87	6.94	6.94	-6.87
502	2	D10K: D10K: Other PT Losses	-0.06	13.51	-13.63	-13.63	13.51
503	0	D10K: D10K: Other PT Losses	0.22	8.23	-7.79	-7.79	8.23
503	1	D10K: D10K: Other PT Losses	0.14	-3.91	4.19	4.19	-3.91
503	2	D10K: D10K: Other PT Losses	0.05	7.99	-7.88	-7.88	7.99
504	0	D10K: D10K: Other PT Losses	0.30	4.17	-3.57	-3.57	4.17
504	1	D10K: D10K: Other PT Losses	0.23	-1.74	2.19	2.19	-1.74
504	2	D10K: D10K: Other PT Losses	0.15	3.98	-3.67	-3.67	3.98
505	0	D10K: D10K: Other PT Losses	0.30	1.53	-0.93	-0.93	1.53
505	1	D10K: D10K: Other PT Losses	0.24	-0.39	0.87	0.87	-0.39
505	2	D10K: D10K: Other PT Losses	0.18	1.46	-1.09	-1.09	1.46
601	0	D10K: D10K: Other PT Losses	0.27	7.91	-7.38	-7.38	7.91
601	1	D10K: D10K: Other PT Losses	0.17	-3.57	3.91	3.91	-3.57
601	2	D10K: D10K: Other PT Losses	0.06	7.40	-7.27	-7.27	7.40
602	0	D10K: D10K: Other PT Losses	0.28	5.85	-5.29	-5.29	5.85
602	1	D10K: D10K: Other PT Losses	0.19	-2.51	2.88	2.88	-2.51
602	2	D10K: D10K: Other PT Losses	0.10	5.42	-5.23	-5.23	5.42
603	0	D10K: D10K: Other PT Losses	0.23	4.04	-3.59	-3.59	4.04
603	1	D10K: D10K: Other PT Losses	0.15	-1.69	1.98	1.98	-1.69
603	2	D10K: D10K: Other PT Losses	0.07	3.68	-3.55	-3.55	3.68
604	0	D10K: D10K: Other PT Losses	0.17	2.55	-2.22	-2.22	2.55
604	1	D10K: D10K: Other PT Losses	0.10	-1.05	1.24	1.24	-1.05
604	2	D10K: D10K: Other PT Losses	0.03	2.28	-2.23	-2.23	2.28
605	0	D10K: D10K: Other PT Losses	0.11	1.39	-1.17	-1.17	1.39
605	1	D10K: D10K: Other PT Losses	0.05	-0.56	0.67	0.67	-0.56
605	2	D10K: D10K: Other PT Losses	-0.01	1.21	-1.23	-1.23	1.21

STEEL PIPES

MEMBER STRESSES
D10K

(-) compression

			NONSTRUCTURAL COMPONENTS (DC)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	D10K: D10K: Other PT Losses	0.02	0.05	-0.01	-0.01	0.05
501	1	D10K: D10K: Other PT Losses	0.02	0.02	0.02	0.02	0.02
501	2	D10K: D10K: Other PT Losses	0.02	-0.02	0.05	0.05	-0.02
502	0	D10K: D10K: Other PT Losses	0.10	0.13	0.06	0.06	0.13
502	1	D10K: D10K: Other PT Losses	0.10	0.10	0.09	0.09	0.10
502	2	D10K: D10K: Other PT Losses	0.10	0.07	0.13	0.13	0.07
503	0	D10K: D10K: Other PT Losses	0.14	0.17	0.11	0.11	0.17
503	1	D10K: D10K: Other PT Losses	0.14	0.15	0.13	0.13	0.15
503	2	D10K: D10K: Other PT Losses	0.14	0.12	0.16	0.16	0.12
504	0	D10K: D10K: Other PT Losses	0.17	0.20	0.14	0.14	0.20
504	1	D10K: D10K: Other PT Losses	0.17	0.17	0.16	0.16	0.17
504	2	D10K: D10K: Other PT Losses	0.17	0.15	0.18	0.18	0.15
505	0	D10K: D10K: Other PT Losses	0.19	0.20	0.17	0.17	0.20
505	1	D10K: D10K: Other PT Losses	0.19	0.20	0.18	0.18	0.20
505	2	D10K: D10K: Other PT Losses	0.19	0.20	0.18	0.18	0.20
601	0	D10K: D10K: Other PT Losses	0.08	0.06	0.11	0.11	0.06
601	1	D10K: D10K: Other PT Losses	0.08	0.08	0.09	0.09	0.08
601	2	D10K: D10K: Other PT Losses	0.08	0.10	0.06	0.06	0.10
602	0	D10K: D10K: Other PT Losses	0.11	0.07	0.14	0.14	0.07
602	1	D10K: D10K: Other PT Losses	0.11	0.10	0.11	0.11	0.10
602	2	D10K: D10K: Other PT Losses	0.11	0.13	0.08	0.08	0.13
603	0	D10K: D10K: Other PT Losses	0.13	0.10	0.16	0.16	0.10
603	1	D10K: D10K: Other PT Losses	0.13	0.13	0.13	0.13	0.13
603	2	D10K: D10K: Other PT Losses	0.13	0.15	0.11	0.11	0.15
604	0	D10K: D10K: Other PT Losses	0.15	0.13	0.18	0.18	0.13
604	1	D10K: D10K: Other PT Losses	0.15	0.15	0.15	0.15	0.15
604	2	D10K: D10K: Other PT Losses	0.15	0.18	0.13	0.13	0.18
605	0	D10K: D10K: Other PT Losses	0.13	0.11	0.16	0.16	0.11
605	1	D10K: D10K: Other PT Losses	0.13	0.14	0.13	0.13	0.14
605	2	D10K: D10K: Other PT Losses	0.13	0.17	0.10	0.10	0.17

STEEL PIPES

MEMBER STRESSES
D10K

(-) compression

			CREEP (CR)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	D10K: D10K: Other PT Losses	-1.68	-1.00	-2.36	-2.36	-1.00
501	1	D10K: D10K: Other PT Losses	-1.68	-1.82	-1.54	-1.54	-1.82
501	2	D10K: D10K: Other PT Losses	-1.68	-2.64	-0.72	-0.72	-2.64
502	0	D10K: D10K: Other PT Losses	0.55	1.23	-0.12	-0.12	1.23
502	1	D10K: D10K: Other PT Losses	0.55	0.55	0.55	0.55	0.55
502	2	D10K: D10K: Other PT Losses	0.55	-0.13	1.23	1.23	-0.13
503	0	D10K: D10K: Other PT Losses	1.62	2.23	1.02	1.02	2.23
503	1	D10K: D10K: Other PT Losses	1.62	1.74	1.51	1.51	1.74
503	2	D10K: D10K: Other PT Losses	1.62	1.25	1.99	2.00	1.25
504	0	D10K: D10K: Other PT Losses	2.07	2.66	1.47	1.47	2.66
504	1	D10K: D10K: Other PT Losses	2.07	2.22	1.91	1.91	2.22
504	2	D10K: D10K: Other PT Losses	2.07	1.79	2.34	2.34	1.79
505	0	D10K: D10K: Other PT Losses	2.45	2.76	2.14	2.14	2.76
505	1	D10K: D10K: Other PT Losses	2.45	2.72	2.18	2.18	2.72
505	2	D10K: D10K: Other PT Losses	2.45	2.68	2.21	2.21	2.69
601	0	D10K: D10K: Other PT Losses	-1.34	-1.08	-1.61	-1.61	-1.08
601	1	D10K: D10K: Other PT Losses	-1.34	-1.46	-1.22	-1.22	-1.46
601	2	D10K: D10K: Other PT Losses	-1.34	-1.85	-0.83	-0.83	-1.85
602	0	D10K: D10K: Other PT Losses	0.44	0.60	0.29	0.29	0.60
602	1	D10K: D10K: Other PT Losses	0.44	0.36	0.53	0.52	0.36
602	2	D10K: D10K: Other PT Losses	0.44	0.13	0.76	0.76	0.12
603	0	D10K: D10K: Other PT Losses	1.60	1.63	1.57	1.57	1.63
603	1	D10K: D10K: Other PT Losses	1.60	1.58	1.62	1.62	1.58
603	2	D10K: D10K: Other PT Losses	1.60	1.54	1.66	1.66	1.54
604	0	D10K: D10K: Other PT Losses	2.29	2.20	2.38	2.38	2.20
604	1	D10K: D10K: Other PT Losses	2.29	2.35	2.23	2.23	2.35
604	2	D10K: D10K: Other PT Losses	2.29	2.51	2.08	2.08	2.50
605	0	D10K: D10K: Other PT Losses	1.95	1.79	2.12	2.12	1.79
605	1	D10K: D10K: Other PT Losses	1.95	2.06	1.85	1.85	2.06
605	2	D10K: D10K: Other PT Losses	1.95	2.33	1.58	1.57	2.33

STEEL PIPES

MEMBER STRESSES
D10K

(-) compression

			SHRINKAGE (SH)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	D10K: D10K: Other PT Losses	-2.98	-2.81	-3.16	-3.16	-2.81
501	1	D10K: D10K: Other PT Losses	-2.98	-3.00	-2.97	-2.97	-3.00
501	2	D10K: D10K: Other PT Losses	-2.98	-3.18	-2.79	-2.79	-3.18
502	0	D10K: D10K: Other PT Losses	-2.06	-1.86	-2.25	-2.25	-1.86
502	1	D10K: D10K: Other PT Losses	-2.06	-2.04	-2.07	-2.07	-2.04
502	2	D10K: D10K: Other PT Losses	-2.06	-2.22	-1.90	-1.90	-2.22
503	0	D10K: D10K: Other PT Losses	-1.30	-1.10	-1.51	-1.51	-1.10
503	1	D10K: D10K: Other PT Losses	-1.30	-1.25	-1.35	-1.35	-1.25
503	2	D10K: D10K: Other PT Losses	-1.30	-1.41	-1.20	-1.20	-1.40
504	0	D10K: D10K: Other PT Losses	-0.53	-0.27	-0.78	-0.78	-0.27
504	1	D10K: D10K: Other PT Losses	-0.53	-0.46	-0.59	-0.59	-0.46
504	2	D10K: D10K: Other PT Losses	-0.53	-0.64	-0.41	-0.41	-0.64
505	0	D10K: D10K: Other PT Losses	0.32	0.49	0.15	0.15	0.49
505	1	D10K: D10K: Other PT Losses	0.32	0.46	0.19	0.19	0.46
505	2	D10K: D10K: Other PT Losses	0.32	0.42	0.22	0.22	0.42
601	0	D10K: D10K: Other PT Losses	-3.51	-3.30	-3.73	-3.73	-3.30
601	1	D10K: D10K: Other PT Losses	-3.51	-3.57	-3.45	-3.45	-3.57
601	2	D10K: D10K: Other PT Losses	-3.51	-3.85	-3.18	-3.18	-3.85
602	0	D10K: D10K: Other PT Losses	-2.32	-2.10	-2.54	-2.54	-2.10
602	1	D10K: D10K: Other PT Losses	-2.32	-2.35	-2.29	-2.29	-2.35
602	2	D10K: D10K: Other PT Losses	-2.32	-2.61	-2.03	-2.03	-2.61
603	0	D10K: D10K: Other PT Losses	-1.39	-1.21	-1.58	-1.58	-1.21
603	1	D10K: D10K: Other PT Losses	-1.39	-1.39	-1.40	-1.40	-1.39
603	2	D10K: D10K: Other PT Losses	-1.39	-1.57	-1.22	-1.22	-1.57
604	0	D10K: D10K: Other PT Losses	-0.63	-0.43	-0.82	-0.82	-0.43
604	1	D10K: D10K: Other PT Losses	-0.63	-0.60	-0.65	-0.65	-0.60
604	2	D10K: D10K: Other PT Losses	-0.63	-0.78	-0.47	-0.47	-0.78
605	0	D10K: D10K: Other PT Losses	0.21	0.32	0.11	0.11	0.32
605	1	D10K: D10K: Other PT Losses	0.21	0.30	0.12	0.12	0.30
605	2	D10K: D10K: Other PT Losses	0.21	0.29	0.14	0.14	0.29

STEEL PIPES

MEMBER STRESSES
D10K

(-) compression

			UTILITIES (DW)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	D10K: D10K: Other PT Losses	0.04	0.10	-0.02	-0.02	0.10
501	1	D10K: D10K: Other PT Losses	0.04	0.03	0.04	0.04	0.03
501	2	D10K: D10K: Other PT Losses	0.04	-0.03	0.10	0.10	-0.03
502	0	D10K: D10K: Other PT Losses	0.18	0.25	0.12	0.12	0.25
502	1	D10K: D10K: Other PT Losses	0.18	0.19	0.18	0.18	0.19
502	2	D10K: D10K: Other PT Losses	0.18	0.13	0.24	0.24	0.13
503	0	D10K: D10K: Other PT Losses	0.26	0.32	0.20	0.20	0.32
503	1	D10K: D10K: Other PT Losses	0.26	0.27	0.25	0.25	0.27
503	2	D10K: D10K: Other PT Losses	0.26	0.23	0.30	0.30	0.23
504	0	D10K: D10K: Other PT Losses	0.31	0.37	0.26	0.26	0.37
504	1	D10K: D10K: Other PT Losses	0.31	0.32	0.30	0.30	0.32
504	2	D10K: D10K: Other PT Losses	0.31	0.28	0.34	0.34	0.28
505	0	D10K: D10K: Other PT Losses	0.35	0.37	0.33	0.33	0.37
505	1	D10K: D10K: Other PT Losses	0.35	0.37	0.33	0.33	0.37
505	2	D10K: D10K: Other PT Losses	0.35	0.37	0.34	0.34	0.37
601	0	D10K: D10K: Other PT Losses	0.15	0.11	0.20	0.20	0.11
601	1	D10K: D10K: Other PT Losses	0.15	0.15	0.16	0.16	0.15
601	2	D10K: D10K: Other PT Losses	0.15	0.19	0.12	0.12	0.19
602	0	D10K: D10K: Other PT Losses	0.21	0.15	0.26	0.26	0.15
602	1	D10K: D10K: Other PT Losses	0.21	0.20	0.21	0.21	0.20
602	2	D10K: D10K: Other PT Losses	0.21	0.25	0.16	0.16	0.25
603	0	D10K: D10K: Other PT Losses	0.25	0.20	0.30	0.30	0.20
603	1	D10K: D10K: Other PT Losses	0.25	0.24	0.25	0.25	0.24
603	2	D10K: D10K: Other PT Losses	0.25	0.29	0.21	0.21	0.29
604	0	D10K: D10K: Other PT Losses	0.29	0.24	0.33	0.33	0.24
604	1	D10K: D10K: Other PT Losses	0.29	0.29	0.29	0.29	0.29
604	2	D10K: D10K: Other PT Losses	0.29	0.33	0.24	0.24	0.33
605	0	D10K: D10K: Other PT Losses	0.25	0.21	0.30	0.30	0.21
605	1	D10K: D10K: Other PT Losses	0.25	0.26	0.25	0.25	0.26
605	2	D10K: D10K: Other PT Losses	0.25	0.32	0.19	0.19	0.32

STEEL PIPES

MEMBER STRESSES
D10K

(-) compression

			LIVE LOAD ON FULL LENGTH OF BRIDGE (LL1)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	D10K: D10K: Other PT Losses	0.13	0.35	-0.09	-0.09	0.35
501	1	D10K: D10K: Other PT Losses	0.13	0.12	0.14	0.14	0.12
501	2	D10K: D10K: Other PT Losses	0.13	-0.11	0.37	0.37	-0.11
502	0	D10K: D10K: Other PT Losses	0.67	0.91	0.43	0.43	0.91
502	1	D10K: D10K: Other PT Losses	0.67	0.69	0.66	0.66	0.69
502	2	D10K: D10K: Other PT Losses	0.67	0.46	0.88	0.88	0.46
503	0	D10K: D10K: Other PT Losses	0.96	1.18	0.75	0.75	1.18
503	1	D10K: D10K: Other PT Losses	0.96	1.01	0.92	0.92	1.01
503	2	D10K: D10K: Other PT Losses	0.96	0.83	1.09	1.09	0.83
504	0	D10K: D10K: Other PT Losses	1.14	1.34	0.94	0.94	1.34
504	1	D10K: D10K: Other PT Losses	1.14	1.18	1.10	1.10	1.18
504	2	D10K: D10K: Other PT Losses	1.14	1.03	1.25	1.25	1.03
505	0	D10K: D10K: Other PT Losses	1.28	1.37	1.19	1.19	1.37
505	1	D10K: D10K: Other PT Losses	1.28	1.35	1.21	1.21	1.35
505	2	D10K: D10K: Other PT Losses	1.28	1.34	1.23	1.23	1.34
601	0	D10K: D10K: Other PT Losses	0.56	0.39	0.74	0.73	0.39
601	1	D10K: D10K: Other PT Losses	0.56	0.54	0.59	0.59	0.54
601	2	D10K: D10K: Other PT Losses	0.56	0.68	0.45	0.45	0.68
602	0	D10K: D10K: Other PT Losses	0.75	0.55	0.95	0.95	0.55
602	1	D10K: D10K: Other PT Losses	0.75	0.73	0.77	0.77	0.73
602	2	D10K: D10K: Other PT Losses	0.75	0.91	0.59	0.59	0.91
603	0	D10K: D10K: Other PT Losses	0.91	0.72	1.10	1.10	0.72
603	1	D10K: D10K: Other PT Losses	0.91	0.89	0.93	0.93	0.89
603	2	D10K: D10K: Other PT Losses	0.91	1.07	0.76	0.76	1.07
604	0	D10K: D10K: Other PT Losses	1.06	0.89	1.22	1.22	0.89
604	1	D10K: D10K: Other PT Losses	1.06	1.06	1.06	1.06	1.06
604	2	D10K: D10K: Other PT Losses	1.06	1.22	0.89	0.89	1.22
605	0	D10K: D10K: Other PT Losses	0.93	0.77	1.09	1.09	0.77
605	1	D10K: D10K: Other PT Losses	0.93	0.96	0.90	0.90	0.96
605	2	D10K: D10K: Other PT Losses	0.93	1.16	0.71	0.71	1.16

STEEL PIPES

MEMBER STRESSES
D10K

(-) compression

			LIVE LOAD ON MAIN SPAN (LL2)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	D10K: D10K: Other PT Losses	-0.06	0.23	-0.35	-0.35	0.23
501	1	D10K: D10K: Other PT Losses	-0.06	-0.06	-0.05	-0.05	-0.06
501	2	D10K: D10K: Other PT Losses	-0.06	-0.36	0.24	0.24	-0.36
502	0	D10K: D10K: Other PT Losses	0.48	0.81	0.16	0.16	0.81
502	1	D10K: D10K: Other PT Losses	0.48	0.51	0.46	0.46	0.51
502	2	D10K: D10K: Other PT Losses	0.48	0.20	0.76	0.76	0.20
503	0	D10K: D10K: Other PT Losses	0.75	1.06	0.45	0.45	1.06
503	1	D10K: D10K: Other PT Losses	0.75	0.81	0.70	0.70	0.81
503	2	D10K: D10K: Other PT Losses	0.75	0.55	0.96	0.96	0.55
504	0	D10K: D10K: Other PT Losses	0.93	1.22	0.64	0.64	1.22
504	1	D10K: D10K: Other PT Losses	0.93	0.98	0.88	0.88	0.98
504	2	D10K: D10K: Other PT Losses	0.93	0.75	1.11	1.11	0.75
505	0	D10K: D10K: Other PT Losses	1.18	1.34	1.02	1.02	1.34
505	1	D10K: D10K: Other PT Losses	1.18	1.26	1.11	1.11	1.26
505	2	D10K: D10K: Other PT Losses	1.18	1.17	1.19	1.19	1.17
601	0	D10K: D10K: Other PT Losses	0.54	0.23	0.85	0.85	0.23
601	1	D10K: D10K: Other PT Losses	0.54	0.51	0.57	0.57	0.51
601	2	D10K: D10K: Other PT Losses	0.54	0.79	0.28	0.29	0.79
602	0	D10K: D10K: Other PT Losses	0.57	0.19	0.94	0.94	0.19
602	1	D10K: D10K: Other PT Losses	0.57	0.54	0.59	0.60	0.54
602	2	D10K: D10K: Other PT Losses	0.57	0.88	0.25	0.25	0.88
603	0	D10K: D10K: Other PT Losses	0.61	0.25	0.98	0.98	0.25
603	1	D10K: D10K: Other PT Losses	0.61	0.58	0.65	0.65	0.58
603	2	D10K: D10K: Other PT Losses	0.61	0.91	0.31	0.31	0.92
604	0	D10K: D10K: Other PT Losses	0.63	0.32	0.94	0.94	0.32
604	1	D10K: D10K: Other PT Losses	0.63	0.61	0.65	0.65	0.61
604	2	D10K: D10K: Other PT Losses	0.63	0.90	0.36	0.36	0.90
605	0	D10K: D10K: Other PT Losses	0.53	0.31	0.74	0.74	0.31
605	1	D10K: D10K: Other PT Losses	0.53	0.52	0.53	0.53	0.52
605	2	D10K: D10K: Other PT Losses	0.53	0.74	0.31	0.31	0.74

STEEL PIPES

MEMBER STRESSES
D10K

(-) compression

			LIVE LOAD ON BACK SPAN (LL3)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	D10K: D10K: Other PT Losses	0.19	0.12	0.26	0.26	0.12
501	1	D10K: D10K: Other PT Losses	0.19	0.18	0.20	0.20	0.19
501	2	D10K: D10K: Other PT Losses	0.19	0.25	0.13	0.13	0.25
502	0	D10K: D10K: Other PT Losses	0.19	0.10	0.28	0.28	0.10
502	1	D10K: D10K: Other PT Losses	0.19	0.18	0.20	0.20	0.18
502	2	D10K: D10K: Other PT Losses	0.19	0.26	0.12	0.12	0.26
503	0	D10K: D10K: Other PT Losses	0.21	0.11	0.30	0.30	0.11
503	1	D10K: D10K: Other PT Losses	0.21	0.20	0.22	0.22	0.20
503	2	D10K: D10K: Other PT Losses	0.21	0.28	0.13	0.13	0.28
504	0	D10K: D10K: Other PT Losses	0.21	0.13	0.30	0.30	0.13
504	1	D10K: D10K: Other PT Losses	0.21	0.20	0.22	0.22	0.20
504	2	D10K: D10K: Other PT Losses	0.21	0.28	0.14	0.14	0.28
505	0	D10K: D10K: Other PT Losses	0.10	0.03	0.17	0.17	0.03
505	1	D10K: D10K: Other PT Losses	0.10	0.10	0.10	0.10	0.10
505	2	D10K: D10K: Other PT Losses	0.10	0.16	0.04	0.04	0.16
601	0	D10K: D10K: Other PT Losses	0.03	0.17	-0.12	-0.12	0.17
601	1	D10K: D10K: Other PT Losses	0.03	0.03	0.02	0.02	0.03
601	2	D10K: D10K: Other PT Losses	0.03	-0.11	0.16	0.16	-0.11
602	0	D10K: D10K: Other PT Losses	0.18	0.36	0.01	0.01	0.36
602	1	D10K: D10K: Other PT Losses	0.18	0.19	0.18	0.18	0.19
602	2	D10K: D10K: Other PT Losses	0.18	0.03	0.34	0.34	0.03
603	0	D10K: D10K: Other PT Losses	0.30	0.47	0.13	0.13	0.47
603	1	D10K: D10K: Other PT Losses	0.30	0.31	0.28	0.28	0.31
603	2	D10K: D10K: Other PT Losses	0.30	0.15	0.44	0.44	0.15
604	0	D10K: D10K: Other PT Losses	0.43	0.57	0.28	0.28	0.57
604	1	D10K: D10K: Other PT Losses	0.43	0.44	0.41	0.41	0.44
604	2	D10K: D10K: Other PT Losses	0.43	0.32	0.53	0.53	0.32
605	0	D10K: D10K: Other PT Losses	0.41	0.46	0.35	0.35	0.46
605	1	D10K: D10K: Other PT Losses	0.41	0.44	0.37	0.37	0.44
605	2	D10K: D10K: Other PT Losses	0.41	0.42	0.40	0.40	0.42

STEEL PIPES

MEMBER STRESSES
D10K

(-) compression

			TEMPERATURE RISE (TU+)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	D10K: D10K: Other PT Losses	-1.03	-1.02	-1.03	-1.03	-1.02
501	1	D10K: D10K: Other PT Losses	-1.03	-1.05	-1.00	-1.00	-1.05
501	2	D10K: D10K: Other PT Losses	-1.03	-1.07	-0.98	-0.98	-1.07
502	0	D10K: D10K: Other PT Losses	-0.51	-0.50	-0.52	-0.52	-0.50
502	1	D10K: D10K: Other PT Losses	-0.51	-0.52	-0.50	-0.50	-0.52
502	2	D10K: D10K: Other PT Losses	-0.51	-0.54	-0.47	-0.47	-0.54
503	0	D10K: D10K: Other PT Losses	0.02	0.01	0.03	0.03	0.01
503	1	D10K: D10K: Other PT Losses	0.02	0.02	0.02	0.02	0.02
503	2	D10K: D10K: Other PT Losses	0.02	0.04	0.00	0.00	0.04
504	0	D10K: D10K: Other PT Losses	0.63	0.64	0.63	0.63	0.64
504	1	D10K: D10K: Other PT Losses	0.63	0.64	0.63	0.63	0.64
504	2	D10K: D10K: Other PT Losses	0.63	0.63	0.64	0.64	0.63
505	0	D10K: D10K: Other PT Losses	0.56	0.38	0.75	0.75	0.38
505	1	D10K: D10K: Other PT Losses	0.56	0.65	0.48	0.48	0.65
505	2	D10K: D10K: Other PT Losses	0.56	0.93	0.20	0.20	0.93
601	0	D10K: D10K: Other PT Losses	-1.08	-1.10	-1.06	-1.06	-1.10
601	1	D10K: D10K: Other PT Losses	-1.08	-1.11	-1.05	-1.05	-1.11
601	2	D10K: D10K: Other PT Losses	-1.08	-1.12	-1.04	-1.04	-1.12
602	0	D10K: D10K: Other PT Losses	-0.60	-0.61	-0.58	-0.58	-0.61
602	1	D10K: D10K: Other PT Losses	-0.60	-0.62	-0.58	-0.58	-0.62
602	2	D10K: D10K: Other PT Losses	-0.60	-0.62	-0.58	-0.58	-0.62
603	0	D10K: D10K: Other PT Losses	-0.14	-0.15	-0.14	-0.14	-0.15
603	1	D10K: D10K: Other PT Losses	-0.14	-0.14	-0.14	-0.14	-0.14
603	2	D10K: D10K: Other PT Losses	-0.14	-0.14	-0.14	-0.14	-0.14
604	0	D10K: D10K: Other PT Losses	0.33	0.40	0.27	0.27	0.40
604	1	D10K: D10K: Other PT Losses	0.33	0.33	0.34	0.34	0.33
604	2	D10K: D10K: Other PT Losses	0.33	0.26	0.41	0.41	0.26
605	0	D10K: D10K: Other PT Losses	1.13	1.11	1.15	1.15	1.11
605	1	D10K: D10K: Other PT Losses	1.13	1.21	1.05	1.05	1.21
605	2	D10K: D10K: Other PT Losses	1.13	1.31	0.95	0.95	1.31

STEEL PIPES

MEMBER STRESSES
D10K

(-) compression

			TEMPERATURE FALL (TU-)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	D10K: D10K: Other PT Losses	1.03	1.02	1.03	1.03	1.02
501	1	D10K: D10K: Other PT Losses	1.03	1.05	1.00	1.00	1.05
501	2	D10K: D10K: Other PT Losses	1.03	1.07	0.98	0.98	1.07
502	0	D10K: D10K: Other PT Losses	0.51	0.50	0.52	0.52	0.50
502	1	D10K: D10K: Other PT Losses	0.51	0.52	0.50	0.50	0.52
502	2	D10K: D10K: Other PT Losses	0.51	0.54	0.47	0.47	0.54
503	0	D10K: D10K: Other PT Losses	-0.02	-0.01	-0.03	-0.03	-0.01
503	1	D10K: D10K: Other PT Losses	-0.02	-0.02	-0.02	-0.02	-0.02
503	2	D10K: D10K: Other PT Losses	-0.02	-0.04	0.00	0.00	-0.04
504	0	D10K: D10K: Other PT Losses	-0.63	-0.64	-0.63	-0.63	-0.64
504	1	D10K: D10K: Other PT Losses	-0.63	-0.64	-0.63	-0.63	-0.64
504	2	D10K: D10K: Other PT Losses	-0.63	-0.63	-0.64	-0.64	-0.63
505	0	D10K: D10K: Other PT Losses	-0.56	-0.38	-0.75	-0.75	-0.38
505	1	D10K: D10K: Other PT Losses	-0.56	-0.65	-0.48	-0.48	-0.65
505	2	D10K: D10K: Other PT Losses	-0.56	-0.93	-0.20	-0.20	-0.93
601	0	D10K: D10K: Other PT Losses	1.08	1.10	1.06	1.06	1.10
601	1	D10K: D10K: Other PT Losses	1.08	1.11	1.05	1.05	1.11
601	2	D10K: D10K: Other PT Losses	1.08	1.12	1.04	1.04	1.12
602	0	D10K: D10K: Other PT Losses	0.60	0.61	0.58	0.58	0.61
602	1	D10K: D10K: Other PT Losses	0.60	0.62	0.58	0.58	0.62
602	2	D10K: D10K: Other PT Losses	0.60	0.62	0.58	0.58	0.62
603	0	D10K: D10K: Other PT Losses	0.14	0.15	0.14	0.14	0.15
603	1	D10K: D10K: Other PT Losses	0.14	0.14	0.14	0.14	0.14
603	2	D10K: D10K: Other PT Losses	0.14	0.14	0.14	0.14	0.14
604	0	D10K: D10K: Other PT Losses	-0.33	-0.40	-0.27	-0.27	-0.40
604	1	D10K: D10K: Other PT Losses	-0.33	-0.33	-0.34	-0.34	-0.33
604	2	D10K: D10K: Other PT Losses	-0.33	-0.26	-0.41	-0.41	-0.26
605	0	D10K: D10K: Other PT Losses	-1.13	-1.11	-1.15	-1.15	-1.11
605	1	D10K: D10K: Other PT Losses	-1.13	-1.21	-1.05	-1.05	-1.21
605	2	D10K: D10K: Other PT Losses	-1.13	-1.31	-0.95	-0.95	-1.31

STEEL PIPES

MEMBER STRESSES
D10K

(-) compression

			TEMP. RISE + TEMP. DIFF. (TU+ + TEMP. DIFF.)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	D10K: D10K: Other PT Losses	-2.57	-2.48	-2.66	-2.66	-2.48
501	1	D10K: D10K: Other PT Losses	-2.57	-2.60	-2.55	-2.55	-2.60
501	2	D10K: D10K: Other PT Losses	-2.57	-2.72	-2.43	-2.43	-2.72
502	0	D10K: D10K: Other PT Losses	-1.60	-1.49	-1.71	-1.71	-1.49
502	1	D10K: D10K: Other PT Losses	-1.60	-1.60	-1.59	-1.59	-1.60
502	2	D10K: D10K: Other PT Losses	-1.60	-1.71	-1.48	-1.48	-1.71
503	0	D10K: D10K: Other PT Losses	-0.70	-0.61	-0.80	-0.80	-0.61
503	1	D10K: D10K: Other PT Losses	-0.70	-0.67	-0.73	-0.73	-0.67
503	2	D10K: D10K: Other PT Losses	-0.70	-0.74	-0.66	-0.66	-0.74
504	0	D10K: D10K: Other PT Losses	0.25	0.38	0.12	0.12	0.38
504	1	D10K: D10K: Other PT Losses	0.25	0.29	0.21	0.21	0.29
504	2	D10K: D10K: Other PT Losses	0.25	0.20	0.31	0.31	0.20
505	0	D10K: D10K: Other PT Losses	0.47	0.35	0.59	0.59	0.35
505	1	D10K: D10K: Other PT Losses	0.47	0.63	0.31	0.31	0.63
505	2	D10K: D10K: Other PT Losses	0.47	0.91	0.03	0.03	0.91
601	0	D10K: D10K: Other PT Losses	-2.89	-2.84	-2.95	-2.95	-2.84
601	1	D10K: D10K: Other PT Losses	-2.89	-2.95	-2.83	-2.83	-2.95
601	2	D10K: D10K: Other PT Losses	-2.89	-3.07	-2.71	-2.71	-3.07
602	0	D10K: D10K: Other PT Losses	-1.82	-1.76	-1.88	-1.88	-1.76
602	1	D10K: D10K: Other PT Losses	-1.82	-1.86	-1.78	-1.78	-1.86
602	2	D10K: D10K: Other PT Losses	-1.82	-1.96	-1.68	-1.68	-1.96
603	0	D10K: D10K: Other PT Losses	-0.92	-0.88	-0.97	-0.97	-0.88
603	1	D10K: D10K: Other PT Losses	-0.92	-0.92	-0.92	-0.92	-0.92
603	2	D10K: D10K: Other PT Losses	-0.92	-0.97	-0.87	-0.87	-0.97
604	0	D10K: D10K: Other PT Losses	-0.12	-0.01	-0.23	-0.23	-0.01
604	1	D10K: D10K: Other PT Losses	-0.12	-0.11	-0.12	-0.12	-0.11
604	2	D10K: D10K: Other PT Losses	-0.12	-0.22	-0.02	-0.02	-0.22
605	0	D10K: D10K: Other PT Losses	0.94	0.91	0.98	0.98	0.91
605	1	D10K: D10K: Other PT Losses	0.94	1.07	0.82	0.82	1.07
605	2	D10K: D10K: Other PT Losses	0.94	1.23	0.66	0.66	1.23

STEEL PIPES

MEMBER STRESSES
D10K

fy (ksi) 46

(-) compression $\sigma_{allow} = 0.6 * fy =$ **27.6 ksi**

			SERVICE II-CASE A (LL ON FULL LENGTH OF BRIDGE)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	D10K: D10K: Other PT Losses	-3	19	-26	-26	19
501	1	D10K: D10K: Other PT Losses	-3	-14	7	7	-14
501	2	D10K: D10K: Other PT Losses	-4	16	-23	-23	16
502	0	D10K: D10K: Other PT Losses	0	15	-15	-15	15
502	1	D10K: D10K: Other PT Losses	0	-7	7	7	-7
502	2	D10K: D10K: Other PT Losses	0	13	-12	-12	13
503	0	D10K: D10K: Other PT Losses	2	11	-7	-7	11
503	1	D10K: D10K: Other PT Losses	2	-2	6	6	-2
503	2	D10K: D10K: Other PT Losses	2	9	-5	-5	9
504	0	D10K: D10K: Other PT Losses	4	10	-1	-1	9
504	1	D10K: D10K: Other PT Losses	4	3	6	6	3
504	2	D10K: D10K: Other PT Losses	4	8	1	1	8
505	0	D10K: D10K: Other PT Losses	6	8	4	4	8
505	1	D10K: D10K: Other PT Losses	6	6	6	6	6
505	2	D10K: D10K: Other PT Losses	6	8	4	4	8
601	0	D10K: D10K: Other PT Losses	-3	5	-10	-10	5
601	1	D10K: D10K: Other PT Losses	-3	-7	1	1	-7
601	2	D10K: D10K: Other PT Losses	-3	4	-9	-9	4
602	0	D10K: D10K: Other PT Losses	0	6	-5	-5	6
602	1	D10K: D10K: Other PT Losses	0	-3	3	3	-3
602	2	D10K: D10K: Other PT Losses	0	5	-5	-5	5
603	0	D10K: D10K: Other PT Losses	2	6	-2	-2	6
603	1	D10K: D10K: Other PT Losses	2	0	4	4	0
603	2	D10K: D10K: Other PT Losses	2	6	-2	-2	6
604	0	D10K: D10K: Other PT Losses	4	6	2	2	6
604	1	D10K: D10K: Other PT Losses	4	3	5	5	3
604	2	D10K: D10K: Other PT Losses	4	6	1	1	6
605	0	D10K: D10K: Other PT Losses	5	6	4	4	6
605	1	D10K: D10K: Other PT Losses	5	5	5	5	5
605	2	D10K: D10K: Other PT Losses	5	7	3	3	7

STEEL PIPES

MEMBER STRESSES
D10K

fy (ksi) 46

(-) compression $\sigma_{allow} = 0.6*fy =$ **27.6 ksi**

			SERVICE II-CASE B (LL ONLY ON MAIN SPAN)				
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)
501	0	D10K: D10K: Other PT Losses	-4	19	-26	-26	19
501	1	D10K: D10K: Other PT Losses	-4	-14	7	7	-14
501	2	D10K: D10K: Other PT Losses	-4	15	-23	-23	15
502	0	D10K: D10K: Other PT Losses	0	15	-15	-15	15
502	1	D10K: D10K: Other PT Losses	0	-7	7	7	-7
502	2	D10K: D10K: Other PT Losses	0	12	-12	-12	12
503	0	D10K: D10K: Other PT Losses	2	11	-7	-7	11
503	1	D10K: D10K: Other PT Losses	2	-2	6	6	-2
503	2	D10K: D10K: Other PT Losses	2	9	-5	-5	9
504	0	D10K: D10K: Other PT Losses	4	9	-1	-1	9
504	1	D10K: D10K: Other PT Losses	4	2	6	6	2
504	2	D10K: D10K: Other PT Losses	4	7	1	1	7
505	0	D10K: D10K: Other PT Losses	6	7	4	4	7
505	1	D10K: D10K: Other PT Losses	6	6	6	6	6
505	2	D10K: D10K: Other PT Losses	6	8	4	4	8
601	0	D10K: D10K: Other PT Losses	-3	5	-10	-10	5
601	1	D10K: D10K: Other PT Losses	-3	-7	1	1	-7
601	2	D10K: D10K: Other PT Losses	-3	4	-10	-10	4
602	0	D10K: D10K: Other PT Losses	0	5	-5	-5	5
602	1	D10K: D10K: Other PT Losses	0	-3	3	3	-3
602	2	D10K: D10K: Other PT Losses	0	5	-5	-5	5
603	0	D10K: D10K: Other PT Losses	2	5	-2	-2	5
603	1	D10K: D10K: Other PT Losses	2	0	4	4	0
603	2	D10K: D10K: Other PT Losses	2	5	-2	-2	5
604	0	D10K: D10K: Other PT Losses	3	6	1	1	6
604	1	D10K: D10K: Other PT Losses	3	2	4	4	2
604	2	D10K: D10K: Other PT Losses	3	6	1	1	6
605	0	D10K: D10K: Other PT Losses	4	5	4	4	5
605	1	D10K: D10K: Other PT Losses	4	4	5	5	4
605	2	D10K: D10K: Other PT Losses	4	7	2	2	7

STEEL PIPES

MEMBER STRESSES
D10K

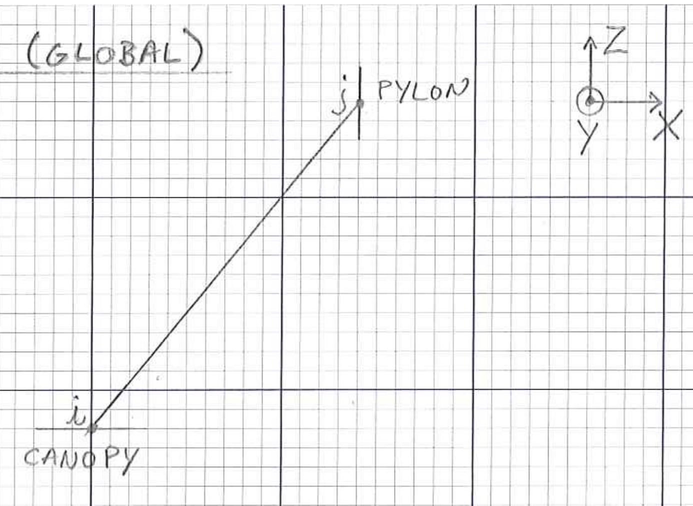
fy (ksi) 46

(-) compression $\sigma_{allow} = 0.6*fy =$ **27.6 ksi**

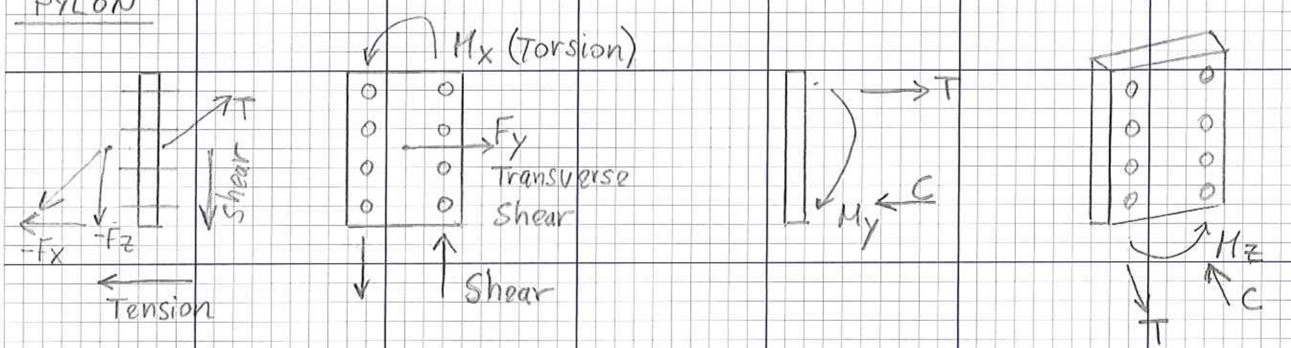
			SERVICE II-CASE C (LL ONLY ON BACK SPAN)					CHECK
Member	Station	Result Case	(P/A) @ Centroid (kips/ft²)	Normal Stress @ Point 1 (kips/ft²)	Normal Stress @ Point 2 (kips/ft²)	Normal Stress @ Point 3 (kips/ft²)	Normal Stress @ Point 4 (kips/ft²)	$\sigma_u <= \sigma_{allow}$
501	0	D10K: D10K: Other PT Losses	-3	19	-25	-25	19	OK
501	1	D10K: D10K: Other PT Losses	-3	-14	7	7	-14	OK
501	2	D10K: D10K: Other PT Losses	-4	16	-23	-23	16	OK
502	0	D10K: D10K: Other PT Losses	0	14	-15	-15	14	OK
502	1	D10K: D10K: Other PT Losses	0	-7	6	6	-7	OK
502	2	D10K: D10K: Other PT Losses	-1	12	-13	-13	12	OK
503	0	D10K: D10K: Other PT Losses	1	10	-8	-8	10	OK
503	1	D10K: D10K: Other PT Losses	1	-3	5	5	-3	OK
503	2	D10K: D10K: Other PT Losses	1	9	-6	-6	9	OK
504	0	D10K: D10K: Other PT Losses	3	8	-1	-1	8	OK
504	1	D10K: D10K: Other PT Losses	3	1	5	5	1	OK
504	2	D10K: D10K: Other PT Losses	3	7	0	0	7	OK
505	0	D10K: D10K: Other PT Losses	4	6	3	3	6	OK
505	1	D10K: D10K: Other PT Losses	4	4	4	4	4	OK
505	2	D10K: D10K: Other PT Losses	4	6	2	2	6	OK
601	0	D10K: D10K: Other PT Losses	-3	5	-11	-11	5	OK
601	1	D10K: D10K: Other PT Losses	-3	-7	1	1	-7	OK
601	2	D10K: D10K: Other PT Losses	-3	3	-10	-10	3	OK
602	0	D10K: D10K: Other PT Losses	0	6	-7	-7	6	OK
602	1	D10K: D10K: Other PT Losses	-1	-3	2	2	-3	OK
602	2	D10K: D10K: Other PT Losses	-1	4	-5	-5	4	OK
603	0	D10K: D10K: Other PT Losses	1	6	-3	-3	6	OK
603	1	D10K: D10K: Other PT Losses	1	-1	3	3	-1	OK
603	2	D10K: D10K: Other PT Losses	1	4	-2	-2	4	OK
604	0	D10K: D10K: Other PT Losses	3	6	0	0	6	OK
604	1	D10K: D10K: Other PT Losses	3	2	4	4	2	OK
604	2	D10K: D10K: Other PT Losses	3	5	1	1	5	OK
605	0	D10K: D10K: Other PT Losses	4	6	3	3	6	OK
605	1	D10K: D10K: Other PT Losses	4	4	5	5	4	OK
605	2	D10K: D10K: Other PT Losses	4	6	2	2	6	OK

FIGG	Project: FIU	Date: 9-30-16	Page 1 Of 1
	Project Number: 2262.03	Designed: EDL	
	Description: ANCHOR BOLT DESIGN	Checked: MF	

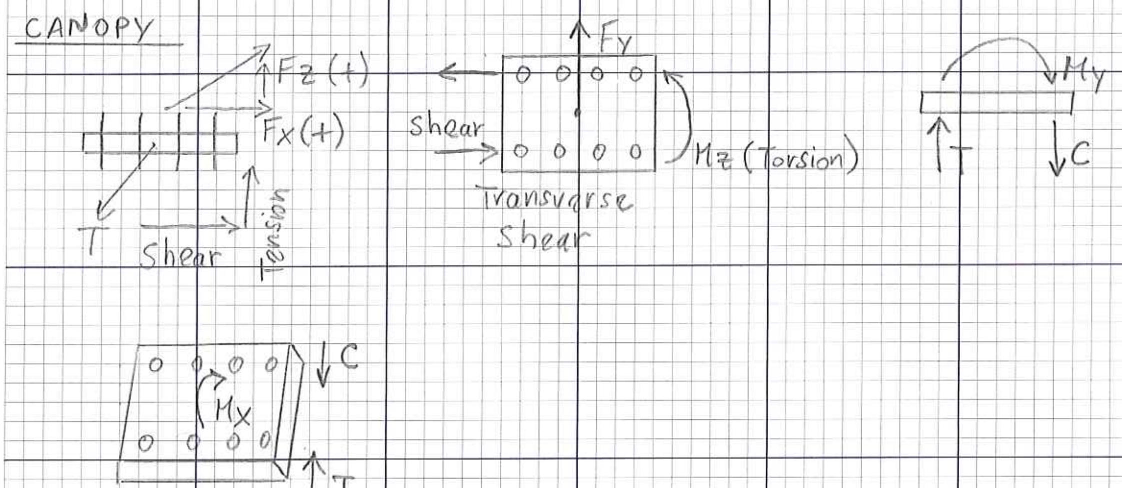
ORIENTATION OF FORCES (GLOBAL)



PYLON



CANOPY



FIGG	Project	Date 9-30-16	Page 1 Of 1
	Project Number	Designed EDL	
	Description ANCHOR BOLT DESIGN	Checked MF	

SAMPLE CALCULATIONS (BOLT FORCES SPREADSHEET)

MEMBER 501 @ PYLON

STR I/8:
(+) tension

5 o		o 1	
6 o		o 2	
7 o		o 3	
8 o		o 4	

$$F_{BOLT_1} = \frac{F_x}{\# bolts} - ML \cdot S_y - MT \cdot S_x$$

$$= \frac{-70K}{8} - 491 K{\cdot}ft \cdot (-0.15) - 7 K{\cdot}ft (0.12)$$

$$= -8.75 + 73.65 - 0.84$$

$$F_{BOLT_1} = 64K\ (T)$$

$$F_{BOLT_8} = \frac{-70K}{8} - 491 K{\cdot}ft (0.15) - 7 K{\cdot}ft (-0.12)$$

$$= -8.75 - 73.65 + 0.84$$

$$F_{BOLT_8} = -82K\ (C)$$

STR 3/10:

$$F_{BOLT_5} = \frac{-67K}{8} - 488 K{\cdot}ft (-0.15) - 237 K{\cdot}ft (-0.12)$$

$$= -8.38 + 73.2 + 28.44$$

$$F_{BOLT_5} = 93K\ (T)$$

BOLT SHEAR FORCE

$$V_{BOLT} = \frac{\sqrt{VT^2 + VL^2}}{\# bolts} + \left| \frac{Torque}{2.08ft} \Big/ \# \text{ bolts in one row} \right|$$

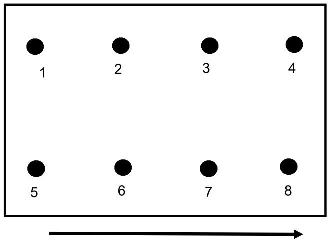
STR 3/20: $$V_{BOLT} = \frac{\sqrt{(-10)^2 + (-156)^2}}{\# bolts} + \left| \frac{-104}{2.08ft} \Big/ 4 \right|$$

$$V_{BOLT} = 19.54K + 12.48K$$

$$V_{BOLT} = 32K$$

Project	FIU Pedestrian Bridge	Date	09/30/16	Page
Project No.	2262.03	Designed	EDL	of
Description	Pipe Connection	Checked	MF	

Bolt Forces - Pylon (Member 501)



Shear Force =sqrt(VT^2 + VL^2)/No. bolts + abs(Torque/2.08ft/4bolts)

2.08ft = distance between centroids of corner bolts

No. Bolts = 8

Bolt No.	1	2	3	4	5	6	7	8
Sx	0.12	0.12	0.12	0.12	-0.12	-0.12	-0.12	-0.12
Sy	-0.15	-0.05	0.05	0.15	-0.15	-0.05	0.05	0.15

Load Combination Summary - Stength I and III Cases

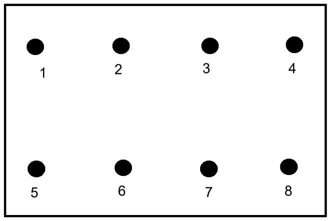
								Bolt Axial Force (positive = tension, negative = compression)								Bolt Forces						
SUMIT LOAD CASE	MEMBER	FX	VT	VL	Torque	ML	MT	Bolt 1	Bolt 2	Bolt 3	Bolt 4	Bolt 5	Bolt 6	Bolt 7	Bolt 8	T_{u_bolt}, Max Tensile Force	T_{u_bolt2}, Max Corner Force	$T_{u\_bolttotal}$, Max Total Tension	Min Corner Force	Shear Force	Total of All Bolt Tensile Forces	Total of All Bolt Compressive
		kips	kips	kips	kip*ft	kip*ft	kip*ft	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips
STR 1/ 57	501	-41	0	-3	0	351	0	47	12	-23	-58	47	12	-23	-58	47	47	120	-58	0	120	-161
STR 1/ 1	501	-55	0	-4	0	493	0	67	18	-31	-81	67	18	-31	-81	67	67	170	-81	0	170	-225
STR 1/ 3	501	-43	0	2	0	485	0	67	19	-30	-78	67	19	-30	-78	67	67	173	-78	0	173	-216
STR 1/ 8	501	-70	0	-10	2	491	7	64	15	-34	-83	66	17	-32	-82	66	66	162	-83	1	162	-231
STR 1/ 47	501	-398	0	-159	0	504	0	26	-25	-75	-125	26	-25	-75	-125	26	26	52	-125	20	52	-450
STR 1/ 8	501	-70	0	-10	2	491	7	64	15	-34	-83	66	17	-32	-82	66	66	162	-83	1	162	-231
STR 1/ 47	501	-398	0	-159	0	504	0	26	-25	-75	-125	26	-25	-75	-125	26	26	52	-125	20	52	-450
STR 1/ 8	501	-70	0	-10	2	491	7	64	15	-34	-83	66	17	-32	-82	66	66	162	-83	1	162	-231
STR 1/ 47	501	-398	0	-159	0	504	0	26	-25	-75	-125	26	-25	-75	-125	26	26	52	-125	20	52	-450
STR 1/ 155	501	-399	0	-160	0	503	0	26	-25	-75	-125	26	-25	-75	-125	26	26	51	-125	20	51	-450
STR 1/ 7	501	-59	0	-6	1	490	7	65	16	-33	-82	67	18	-31	-80	67	67	167	-82	1	167	-226
STR 1/ 209	501	-397	0	-165	0	369	0	6	-31	-68	-105	6	-31	-68	-105	6	6	11	-105	21	11	-409
STR 1/ 9	501	-53	0	-3	0	487	0	66	18	-31	-80	66	18	-31	-80	66	66	168	-80	0	168	-221
STR 1/ 174	501	-121	0	-40	0	349	0	37	2	-33	-67	37	2	-33	-67	37	37	79	-67	5	79	-200
STR 1/ 9	501	-53	0	-3	0	487	0	66	18	-31	-80	66	18	-31	-80	66	66	168	-80	0	168	-221
STR 1/ 174	501	-121	0	-40	0	349	0	37	2	-33	-67	37	2	-33	-67	37	37	79	-67	5	79	-200
STR 1/ 1	501	-55	0	-4	0	493	0	67	18	-31	-81	67	18	-31	-81	67	67	170	-81	0	170	-225
STR 1/ 174	501	-121	0	-40	0	349	0	37	2	-33	-67	37	2	-33	-67	37	37	79	-67	5	79	-200
STR 3/ 129	501	-60	-5	-16	-52	263	114	18	-8	-34	-61	46	19	-7	-33	46	46	83	-61	8	83	-143
STR 3/ 5	501	-66	-5	-5	-52	577	114	65	7	-51	-108	92	34	-23	-81	92	92	198	-108	7	198	-264
STR 3/ 5	501	-66	-5	-5	-52	577	114	65	7	-51	-108	92	34	-23	-81	92	92	198	-108	7	198	-264
STR 3/ 5	501	-66	-5	-5	-52	577	114	65	7	-51	-108	92	34	-23	-81	92	92	198	-108	7	198	-264
STR 3/ 55	501	-388	-5	-151	-52	586	114	26	-33	-91	-150	53	-6	-64	-123	53	53	79	-150	25	79	-467
STR 3/ 10	501	-67	-10	-9	-104	488	237	36	-12	-61	-110	93	45	-4	-53	93	93	174	-110	14	174	-241
STR 3/ 55	501	-388	-5	-151	-52	586	114	26	-33	-91	-150	53	-6	-64	-123	53	53	79	-150	25	79	-467
STR 3/ 10	501	-67	-10	-9	-104	488	237	36	-12	-61	-110	93	45	-4	-53	93	93	174	-110	14	174	-241
STR 3/ 55	501	-388	-5	-151	-52	586	114	26	-33	-91	-150	53	-6	-64	-123	53	53	79	-150	25	79	-467
STR 3/ 120	501	-391	-10	-156	-104	496	237	-3	-53	-102	-152	54	4	-45	-95	54	54	58	-152	32	58	-449
STR 3/ 10	501	-67	-10	-9	-104	488	237	36	-12	-61	-110	93	45	-4	-53	93	93	174	-110	14	174	-241
STR 3/ 239	501	-384	-5	-163	-52	271	114	-21	-48	-75	-102	6	-21	-48	-75	6	6	6	-102	27	6	-390
STR 3/ 1	501	-64	-10	-8	-105	488	232	37	-11	-60	-109	93	44	-5	-53	93	93	175	-109	14	175	-238
STR 3/ 199	501	-140	-5	-52	-52	262	114	8	-18	-44	-70	36	9	-17	-43	36	36	53	-70	13	53	-193
STR 3/ 5	501	-66	-5	-5	-52	577	114	65	7	-51	-108	92	34	-23	-81	92	92	198	-108	7	198	-264
STR 3/ 199	501	-140	-5	-52	-52	262	114	8	-18	-44	-70	36	9	-17	-43	36	36	53	-70	13	53	-193
STR 3/ 5	501	-66	-5	-5	-52	577	114	65	7	-51	-108	92	34	-23	-81	92	92	198	-108	7	198	-264
STR 3/ 199	501	-140	-5	-52	-52	262	114	8	-18	-44	-70	36	9	-17	-43	36	36	53	-70	13	53	-193
															Maximum/Minimum Strength 1 & 3 Cases =	93	93	198	-152	32		-467

File: Bolt Forces_All Locations_Pylon_Main Span Side_9.30.2016.xls
Tab: Pylon Conn._M501

Sheet 1 of 6

Project: **FIU Pedestrian Bridge**		Date: **09/30/16**	Page ___ of ___
FIGG	Project No.: **2262.03**	Designed: **EDL**	
	Description: **Pipe Connection**	Checked: **MF**	

Bolt Forces - Pylon (Member 502)



longitudinal

Shear Force =sqrt(VT^2 + VL^2)/No. bolts + abs(Torque/2.08ft/4bolts)

2.08ft = distance between centroids of corner bolts

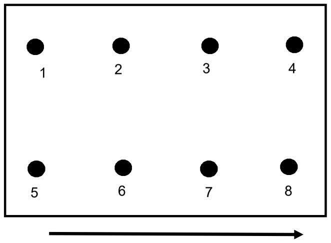
No. Bolts =	8							
Bolt No.	1	2	3	4	5	6	7	8
Sx	0.12	0.12	0.12	0.12	-0.12	-0.12	-0.12	-0.12
Sy	-0.15	-0.05	0.05	0.15	-0.15	-0.05	0.05	0.15

Load Combination Summary - Stength I and III Cases

SUMIT LOAD CASE	MEMBER	FX	VT	VL	Torque	ML	MT	Bolt Axial Force (positive = tension, negative = compression) Bolt 1	Bolt 2	Bolt 3	Bolt 4	Bolt 5	Bolt 6	Bolt 7	Bolt 8	Bolt Forces T_{u_bolt}, Max Tensile Force	T_{u_bolt2}, Max Corner Force	$T_{u\_bolttotal}$, Max Total Tension	Min Corner Force	Shear Force	Total of All Bolt Tensile Forces	Total of All Bolt Compressive
		kips	kips	kips	kip*ft	kip*ft	kip*ft	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips
STR 1/ 1	502	93	0	65	0	331	0	61	28	-5	-38	61	28	-5	-38	61	61	179	-38	8	179	-86
STR 1/ 1	502	93	0	65	0	331	0	61	28	-5	-38	61	28	-5	-38	61	61	179	-38	8	179	-86
STR 1/ 1	502	93	0	65	0	331	0	61	28	-5	-38	61	28	-5	-38	61	61	179	-38	8	179	-86
STR 1/ 8	502	51	0	44	1	329	7	55	22	-11	-44	56	24	-9	-42	56	56	157	-44	6	157	-106
STR 1/ 47	502	-91	0	-28	0	345	0	40	6	-29	-63	40	6	-29	-63	40	40	93	-63	4	93	-184
STR 1/ 8	502	51	0	44	1	329	7	55	22	-11	-44	56	24	-9	-42	56	56	157	-44	6	157	-106
STR 1/ 47	502	-91	0	-28	0	345	0	40	6	-29	-63	40	6	-29	-63	40	40	93	-63	4	93	-184
STR 1/ 8	502	51	0	44	1	329	7	55	22	-11	-44	56	24	-9	-42	56	56	157	-44	6	157	-106
STR 1/ 47	502	-91	0	-28	0	345	0	40	6	-29	-63	40	6	-29	-63	40	40	93	-63	4	93	-184
STR 1/ 213	502	-143	0	-59	0	245	0	19	-6	-30	-55	19	-6	-30	-55	19	19	38	-55	7	38	-180
STR 1/ 7	502	62	0	49	1	327	6	56	23	-9	-42	58	25	-8	-41	58	58	162	-42	6	162	-100
STR 1/ 213	502	-143	0	-59	0	245	0	19	-6	-30	-55	19	-6	-30	-55	19	19	38	-55	7	38	-180
STR 1/ 9	502	40	0	38	0	322	0	53	21	-11	-43	53	21	-11	-43	53	53	149	-43	5	149	-109
STR 1/ 174	502	-15	0	5	0	231	0	33	10	-13	-37	33	10	-13	-37	33	33	85	-37	1	85	-100
STR 1/ 9	502	40	0	38	0	322	0	53	21	-11	-43	53	21	-11	-43	53	53	149	-43	5	149	-109
STR 1/ 174	502	-15	0	5	0	231	0	33	10	-13	-37	33	10	-13	-37	33	33	85	-37	1	85	-100
STR 1/ 1	502	93	0	65	0	331	0	61	28	-5	-38	61	28	-5	-38	61	61	179	-38	8	179	-86
STR 1/ 174	502	-15	0	5	0	231	0	33	10	-13	-37	33	10	-13	-37	33	33	85	-37	1	85	-100
STR 3/ 5	502	31	-4	37	-38	387	74	53	14	-24	-63	71	32	-7	-45	71	71	171	-63	9	171	-139
STR 3/ 5	502	31	-4	37	-38	387	74	53	14	-24	-63	71	32	-7	-45	71	71	171	-63	9	171	-139
STR 3/ 5	502	31	-4	37	-38	387	74	53	14	-24	-63	71	32	-7	-45	71	71	171	-63	9	171	-139
STR 3/ 5	502	31	-4	37	-38	387	74	53	14	-24	-63	71	32	-7	-45	71	71	171	-63	9	171	-139
STR 3/ 55	502	-133	-4	-46	-38	399	74	34	-6	-45	-85	52	12	-28	-68	52	52	99	-85	10	99	-231
STR 3/ 10	502	12	-8	24	-77	320	157	31	-1	-33	-65	68	36	4	-28	68	68	140	-65	12	140	-128
STR 3/ 55	502	-133	-4	-46	-38	399	74	34	-6	-45	-85	52	12	-28	-68	52	52	99	-85	10	99	-231
STR 3/ 10	502	12	-8	24	-77	320	157	31	-1	-33	-65	68	36	4	-28	68	68	140	-65	12	140	-128
STR 3/ 55	502	-133	-4	-46	-38	399	74	34	-6	-45	-85	52	12	-28	-68	52	52	99	-85	10	99	-231
STR 3/ 240	502	-163	-8	-69	-77	242	157	-3	-27	-51	-76	35	11	-14	-38	35	35	45	-76	18	45	-208
STR 3/ 1	502	30	-8	33	-77	323	152	34	2	-31	-63	70	38	6	-27	70	70	150	-63	13	150	-120
STR 3/ 240	502	-163	-8	-69	-77	242	157	-3	-27	-51	-76	35	11	-14	-38	35	35	45	-76	18	45	-208
STR 3/ 1	502	30	-8	33	-77	323	152	34	2	-31	-63	70	38	6	-27	70	70	150	-63	13	150	-120
STR 3/ 199	502	-37	-4	-10	-38	169	74	12	-5	-22	-39	30	13	-4	-21	30	30	54	-39	6	54	-91
STR 3/ 5	502	31	-4	37	-38	387	74	53	14	-24	-63	71	32	-7	-45	71	71	171	-63	9	171	-139
STR 3/ 199	502	-37	-4	-10	-38	169	74	12	-5	-22	-39	30	13	-4	-21	30	30	54	-39	6	54	-91
STR 3/ 5	502	31	-4	37	-38	387	74	53	14	-24	-63	71	32	-7	-45	71	71	171	-63	9	171	-139
STR 3/ 199	502	-37	-4	-10	-38	169	74	12	-5	-22	-39	30	13	-4	-21	30	30	54	-39	6	54	-91
														Maximum/Minimum Strength 1 & 3 Cases =		71	71	179	-85	18		-231

Project	FIU Pedestrian Bridge	Date	09/30/16	Page
Project No.	2262.03	Designed	EDL	of
Description	Pipe Connection	Checked	MF	

Bolt Forces - Pylon (Member 503)



Shear Force =sqrt($VT^2 + VL^2$)/No. bolts + abs(Torque/2.08ft/4bolts)

2.08ft = distance between centroids of corner bolts

No. Bolts = 8

Bolt No.	1	2	3	4	5	6	7	8
Sx	0.12	0.12	0.12	0.12	-0.12	-0.12	-0.12	-0.12
Sy	-0.15	-0.05	0.05	0.15	-0.15	-0.05	0.05	0.15

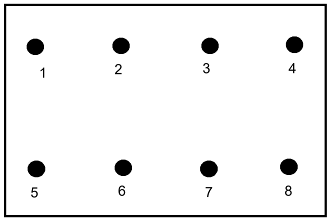
Load Combination Summary - Stength I and III Cases

								Bolt Axial Force (positive = tension, negative = compression)								Bolt Forces						
SUMIT LOAD CASE	MEMBER	FX	VT	VL	Torque	ML	MT	Bolt 1	Bolt 2	Bolt 3	Bolt 4	Bolt 5	Bolt 6	Bolt 7	Bolt 8	T_{u_bolt}, Max Tensile Force	T_{u_bolt2}, Max Corner Force	$T_{u\_bolttotal}$, Max Total Tension	Min Corner Force	Shear Force	Total of All Bolt Tensile Forces	Total of All Bolt Compressive
		kips	kips	kips	kip*ft	kip*ft	kip*ft	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips
STR 1/ 1	503	177	0	118	0	201	0	52	32	12	-8	52	32	12	-8	52	52	193	-8	15	193	-16
STR 1/ 1	503	177	0	118	0	201	0	52	32	12	-8	52	32	12	-8	52	52	193	-8	15	193	-16
STR 1/ 1	503	177	0	118	0	201	0	52	32	12	-8	52	32	12	-8	52	52	193	-8	15	193	-16
STR 1/ 1	503	177	0	118	0	201	0	52	32	12	-8	52	32	12	-8	52	52	193	-8	15	193	-16
STR 1/ 47	503	85	0	64	0	215	0	43	21	0	-22	43	21	0	-22	43	43	129	-22	8	129	-43
STR 1/ 8	503	120	0	85	0	199	6	44	24	4	-15	46	26	6	-14	46	46	150	-15	11	150	-29
STR 1/ 47	503	85	0	64	0	215	0	43	21	0	-22	43	21	0	-22	43	43	129	-22	8	129	-43
STR 1/ 8	503	120	0	85	0	199	6	44	24	4	-15	46	26	6	-14	46	46	150	-15	11	150	-29
STR 1/ 47	503	85	0	64	0	215	0	43	21	0	-22	43	21	0	-22	43	43	129	-22	8	129	-43
STR 1/ 213	503	1	0	11	0	151	0	23	8	-7	-23	23	8	-7	-23	23	23	61	-23	1	61	-60
STR 1/ 7	503	131	0	91	0	197	6	45	26	6	-14	47	27	7	-12	47	47	158	-14	11	158	-26
STR 1/ 213	503	1	0	11	0	151	0	23	8	-7	-23	23	8	-7	-23	23	23	61	-23	1	61	-60
STR 1/ 7	503	131	0	91	0	197	6	45	26	6	-14	47	27	7	-12	47	47	158	-14	11	158	-26
STR 1/ 174	503	51	0	40	0	137	0	27	13	-1	-14	27	13	-1	-14	27	27	80	-14	5	80	-29
STR 1/ 9	503	96	0	71	0	192	-1	41	22	3	-17	41	22	2	-17	41	41	130	-17	9	130	-33
STR 1/ 174	503	51	0	40	0	137	0	27	13	-1	-14	27	13	-1	-14	27	27	80	-14	5	80	-29
STR 1/ 1	503	177	0	118	0	201	0	52	32	12	-8	52	32	12	-8	52	52	193	-8	15	193	-16
STR 1/ 174	503	51	0	40	0	137	0	27	13	-1	-14	27	13	-1	-14	27	27	80	-14	5	80	-29
STR 3/ 5	503	89	-3	69	-27	237	42	42	18	-6	-29	52	28	4	-19	52	52	143	-29	12	143	-55
STR 3/ 5	503	89	-3	69	-27	237	42	42	18	-6	-29	52	28	4	-19	52	52	143	-29	12	143	-55
STR 3/ 5	503	89	-3	69	-27	237	42	42	18	-6	-29	52	28	4	-19	52	52	143	-29	12	143	-55
STR 3/ 5	503	89	-3	69	-27	237	42	42	18	-6	-29	52	28	4	-19	52	52	143	-29	12	143	-55
STR 3/ 55	503	19	-3	28	-27	248	42	34	10	-15	-40	45	20	-5	-30	45	45	109	-40	7	109	-90
STR 3/ 10	503	60	-7	49	-55	191	93	25	6	-13	-32	47	28	9	-10	47	47	116	-32	13	116	-55
STR 3/ 55	503	19	-3	28	-27	248	42	34	10	-15	-40	45	20	-5	-30	45	45	109	-40	7	109	-90
STR 3/ 10	503	60	-7	49	-55	191	93	25	6	-13	-32	47	28	9	-10	47	47	116	-32	13	116	-55
STR 3/ 55	503	19	-3	28	-27	248	42	34	10	-15	-40	45	20	-5	-30	45	45	109	-40	7	109	-90
STR 3/ 240	503	-27	-7	-6	-55	150	93	8	-7	-22	-37	30	15	0	-15	30	30	54	-37	8	54	-81
STR 3/ 10	503	60	-7	49	-55	191	93	25	6	-13	-32	47	28	9	-10	47	47	116	-32	13	116	-55
STR 3/ 240	503	-27	-7	-6	-55	150	93	8	-7	-22	-37	30	15	0	-15	30	30	54	-37	8	54	-81
STR 3/ 1	503	86	-6	64	-55	193	87	29	10	-9	-29	50	31	11	-8	50	50	132	-29	15	132	-46
STR 3/ 199	503	25	-3	22	-27	96	42	13	3	-7	-16	23	13	3	-6	23	23	55	-16	6	55	-29
STR 3/ 5	503	89	-3	69	-27	237	42	42	18	-6	-29	52	28	4	-19	52	52	143	-29	12	143	-55
STR 3/ 199	503	25	-3	22	-27	96	42	13	3	-7	-16	23	13	3	-6	23	23	55	-16	6	55	-29
STR 3/ 5	503	89	-3	69	-27	237	42	42	18	-6	-29	52	28	4	-19	52	52	143	-29	12	143	-55
STR 3/ 199	503	25	-3	22	-27	96	42	13	3	-7	-16	23	13	3	-6	23	23	55	-16	6	55	-29
															Maximum/Minimum Strength 1 & 3 Cases =	52	52	193	-40	15		-90

File: Bolt Forces_All Locations_Pylon_Main Span Side_9.30.2016.xls
Tab: Pylon Conn._M503

Project	FIU Pedestrian Bridge	Date	09/30/16	Page
Project No.	2262.03	Designed	EDL	of
Description	Pipe Connection	Checked	MF	

Bolt Forces - Pylon (Member 504)



longitudinal

Shear Force =sqrt(VT^2 + VL^2)/No. bolts + abs(Torque/2.08ft/4bolts)

2.08ft = distance between centroids of corner bolts

No. Bolts =	8							
Bolt No.	1	2	3	4	5	6	7	8
Sx	0.12	0.12	0.12	0.12	-0.12	-0.12	-0.12	-0.12
Sy	-0.15	-0.05	0.05	0.15	-0.15	-0.05	0.05	0.15

Load Combination Summary - Stength I and III Cases

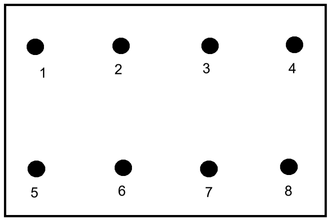
								Bolt Axial Force (positive = tension, negative = compression)								Bolt Forces						
SUMIT LOAD CASE	MEMBER	FX	VT	VL	Torque	ML	MT	Bolt 1	Bolt 2	Bolt 3	Bolt 4	Bolt 5	Bolt 6	Bolt 7	Bolt 8	T_{u_bolt}, Max Tensile Force	T_{u_bolt2}, Max Corner Force	$T_{u\_bolttotal}$, Max Total Tension	Min Corner Force	Shear Force	Total of All Bolt Tensile Forces	Total of All Bolt Compressive
		kips	kips	kips	kip*ft	kip*ft	kip*ft	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips
STR 1/ 28	504	251	0	202	0	117	0	49	37	26	14	49	37	26	14	49	49	251	14	25	251	0
STR 1/ 1	504	221	0	178	0	105	0	43	33	22	12	43	33	22	12	43	43	221	12	22	221	0
STR 1/ 28	504	251	0	202	0	117	0	49	37	26	14	49	37	26	14	49	49	251	14	25	251	0
STR 1/ 1	504	221	0	178	0	105	0	43	33	22	12	43	33	22	12	43	43	221	12	22	221	0
STR 1/ 29	504	231	0	186	0	120	0	47	35	23	11	47	35	23	11	47	47	231	11	23	231	0
STR 1/ 8	504	161	0	132	-1	104	6	35	25	14	4	36	26	16	5	36	36	161	4	17	161	0
STR 1/ 29	504	231	0	186	0	120	0	47	35	23	11	47	35	23	11	47	47	231	11	23	231	0
STR 1/ 8	504	161	0	132	-1	104	6	35	25	14	4	36	26	16	5	36	36	161	4	17	161	0
STR 1/ 29	504	231	0	186	0	120	0	47	35	23	11	47	35	23	11	47	47	231	11	23	231	0
STR 1/ 186	504	55	0	49	0	72	0	18	11	3	-4	18	11	3	-4	18	18	63	-4	6	63	-8
STR 1/ 7	504	171	0	140	-1	102	5	36	26	16	5	37	27	17	7	37	37	171	5	18	171	0
STR 1/ 186	504	55	0	49	0	72	0	18	11	3	-4	18	11	3	-4	18	18	63	-4	6	63	-8
STR 1/ 8	504	161	0	132	-1	104	6	35	25	14	4	36	26	16	5	36	36	161	4	17	161	0
STR 1/ 174	504	84	0	71	0	68	0	21	14	7	0	21	14	7	0	21	21	84	0	9	84	0
STR 1/ 9	504	131	0	109	0	97	-1	31	21	12	2	31	21	11	2	31	31	131	2	14	131	0
STR 1/ 174	504	84	0	71	0	68	0	21	14	7	0	21	14	7	0	21	21	84	0	9	84	0
STR 1/ 1	504	221	0	178	0	105	0	43	33	22	12	43	33	22	12	43	43	221	12	22	221	0
STR 1/ 174	504	84	0	71	0	68	0	21	14	7	0	21	14	7	0	21	21	84	0	9	84	0
STR 3/ 35	504	152	-2	129	-18	136	19	37	24	10	-4	42	28	14	1	42	42	156	-4	18	156	-4
STR 3/ 5	504	122	-2	106	-18	125	19	32	19	7	-6	36	24	11	-1	36	36	129	-6	15	129	-7
STR 3/ 35	504	152	-2	129	-18	136	19	37	24	10	-4	42	28	14	1	42	42	156	-4	18	156	-4
STR 3/ 5	504	122	-2	106	-18	125	19	32	19	7	-6	36	24	11	-1	36	36	129	-6	15	129	-7
STR 3/ 35	504	152	-2	129	-18	136	19	37	24	10	-4	42	28	14	1	42	42	156	-4	18	156	-4
STR 3/ 10	504	92	-5	80	-38	97	45	21	11	1	-9	31	22	12	2	31	31	100	-9	15	100	-9
STR 3/ 35	504	152	-2	129	-18	136	19	37	24	10	-4	42	28	14	1	42	42	156	-4	18	156	-4
STR 3/ 10	504	92	-5	80	-38	97	45	21	11	1	-9	31	22	12	2	31	31	100	-9	15	100	-9
STR 3/ 35	504	152	-2	129	-18	136	19	37	24	10	-4	42	28	14	1	42	42	156	-4	18	156	-4
STR 3/ 210	504	24	-5	26	-38	70	45	8	1	-6	-13	19	12	5	-2	19	19	45	-13	8	45	-21
STR 3/ 10	504	92	-5	80	-38	97	45	21	11	1	-9	31	22	12	2	31	31	100	-9	15	100	-9
STR 3/ 210	504	24	-5	26	-38	70	45	8	1	-6	-13	19	12	5	-2	19	19	45	-13	8	45	-21
STR 3/ 10	504	92	-5	80	-38	97	45	21	11	1	-9	31	22	12	2	31	31	100	-9	15	100	-9
STR 3/ 199	504	62	-2	51	-18	45	19	12	8	3	-1	17	12	8	3	17	17	63	-1	9	63	-1
STR 3/ 5	504	122	-2	106	-18	125	19	32	19	7	-6	36	24	11	-1	36	36	129	-6	15	129	-7
STR 3/ 199	504	62	-2	51	-18	45	19	12	8	3	-1	17	12	8	3	17	17	63	-1	9	63	-1
STR 3/ 5	504	122	-2	106	-18	125	19	32	19	7	-6	36	24	11	-1	36	36	129	-6	15	129	-7
STR 3/ 199	504	62	-2	51	-18	45	19	12	8	3	-1	17	12	8	3	17	17	63	-1	9	63	-1
															Maximum/Minimum Strength 1 & 3 Cases =	49	49	251	-13	25		-21

File: Bolt Forces_All Locations_Pylon_Main Span Side_9.30.2016.xls
Tab: Pylon Conn._M504

Project	Date	Page
FIU Pedestrian Bridge	09/30/16	of
Project No. 2262.03	Designed EDL	
Description Pipe Connection	Checked MF	

FIGG

Bolt Forces - Pylon (Member 505)



longitudinal

Shear Force =sqrt(VT^2 + VL^2)/No. bolts + abs(Torque/2.08ft/4bolts)

2.08ft = distance between centroids of corner bolts

No. Bolts =	8							
Bolt No.	1	2	3	4	5	6	7	8
Sx	0.12	0.12	0.12	0.12	-0.12	-0.12	-0.12	-0.12
Sy	-0.15	-0.05	0.05	0.15	-0.15	-0.05	0.05	0.15

Load Combination Summary - Stength I and III Cases

								Bolt Axial Force (positive = tension, negative = compression)								Bolt Forces						
SUMIT LOAD CASE	MEMBER	FX	VT	VL	Torque	ML	MT	Bolt 1	Bolt 2	Bolt 3	Bolt 4	Bolt 5	Bolt 6	Bolt 7	Bolt 8	T_{u_bolt}, Max Tensile Force	T_{u_bolt2}, Max Corner Force	$T_{u\_bolttotal}$, Max Total Tension	Min Corner Force	Shear Force	Total of All Bolt Tensile Forces	Total of All Bolt Compressive
		kips	kips	kips	kip*ft	kip*ft	kip*ft	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips
STR 1/ 28	505	268	0	348	0	52	0	41	36	31	26	41	36	31	26	41	41	268	26	44	268	0
STR 1/ 9	505	139	0	182	1	37	-1	23	19	16	12	23	19	15	12	23	23	139	12	23	139	0
STR 1/ 28	505	268	0	348	0	52	0	41	36	31	26	41	36	31	26	41	41	268	26	44	268	0
STR 1/ 9	505	139	0	182	1	37	-1	23	19	16	12	23	19	15	12	23	23	139	12	23	139	0
STR 1/ 29	505	260	0	338	0	55	0	41	35	30	24	41	35	30	24	41	41	260	24	42	260	0
STR 1/ 8	505	173	0	226	-2	42	3	28	23	19	15	28	24	20	16	28	28	173	15	28	173	0
STR 1/ 29	505	260	0	338	0	55	0	41	35	30	24	41	35	30	24	41	41	260	24	42	260	0
STR 1/ 8	505	173	0	226	-2	42	3	28	23	19	15	28	24	20	16	28	28	173	15	28	173	0
STR 1/ 29	505	260	0	338	0	55	0	41	35	30	24	41	35	30	24	41	41	260	24	42	260	0
STR 1/ 186	505	50	0	68	0	26	0	10	8	5	2	10	8	5	2	10	10	50	2	9	50	0
STR 1/ 8	505	173	0	226	-2	42	3	28	23	19	15	28	24	20	16	28	28	173	15	28	173	0
STR 1/ 186	505	50	0	68	0	26	0	10	8	5	2	10	8	5	2	10	10	50	2	9	50	0
STR 1/ 8	505	173	0	226	-2	42	3	28	23	19	15	28	24	20	16	28	28	173	15	28	173	0
STR 1/ 174	505	60	0	81	0	23	0	11	9	6	4	11	9	6	4	11	11	60	4	10	60	0
STR 1/ 9	505	139	0	182	1	37	-1	23	19	16	12	23	19	15	12	23	23	139	12	23	139	0
STR 1/ 174	505	60	0	81	0	23	0	11	9	6	4	11	9	6	4	11	11	60	4	10	60	0
STR 1/ 1	505	219	0	285	0	43	0	34	29	25	21	34	29	25	21	34	34	219	21	36	219	0
STR 1/ 174	505	60	0	81	0	23	0	11	9	6	4	11	9	6	4	11	11	60	4	10	60	0
STR 3/ 39	505	191	-1	246	-12	34	4	29	25	22	18	29	26	23	19	29	29	191	18	32	191	0
STR 3/ 5	505	128	-1	172	-12	52	4	23	18	13	8	24	19	14	9	24	24	128	8	23	128	0
STR 3/ 39	505	191	-1	246	-12	34	4	29	25	22	18	29	26	23	19	29	29	191	18	32	191	0
STR 3/ 5	505	128	-1	172	-12	52	4	23	18	13	8	24	19	14	9	24	24	128	8	23	128	0
STR 3/ 35	505	177	-1	235	-12	61	4	31	25	19	12	32	26	19	13	32	32	177	12	31	177	0
STR 3/ 10	505	110	-3	146	-27	37	13	18	14	10	7	21	17	13	10	21	21	110	7	21	110	0
STR 3/ 35	505	177	-1	235	-12	61	4	31	25	19	12	32	26	19	13	32	32	177	12	31	177	0
STR 3/ 10	505	110	-3	146	-27	37	13	18	14	10	7	21	17	13	10	21	21	110	7	21	110	0
STR 3/ 35	505	177	-1	235	-12	61	4	31	25	19	12	32	26	19	13	32	32	177	12	31	177	0
STR 3/ 210	505	24	-3	36	-27	25	13	5	3	0	-2	8	6	3	1	8	8	27	-2	8	27	-2
STR 3/ 10	505	110	-3	146	-27	37	13	18	14	10	7	21	17	13	10	21	21	110	7	21	110	0
STR 3/ 210	505	24	-3	36	-27	25	13	5	3	0	-2	8	6	3	1	8	8	27	-2	8	27	-2
STR 3/ 10	505	110	-3	146	-27	37	13	18	14	10	7	21	17	13	10	21	21	110	7	21	110	0
STR 3/ 199	505	59	-1	76	-12	12	4	9	8	6	5	10	8	7	6	10	10	59	5	11	59	0
STR 3/ 5	505	128	-1	172	-12	52	4	23	18	13	8	24	19	14	9	24	24	128	8	23	128	0
STR 3/ 199	505	59	-1	76	-12	12	4	9	8	6	5	10	8	7	6	10	10	59	5	11	59	0
STR 3/ 5	505	128	-1	172	-12	52	4	23	18	13	8	24	19	14	9	24	24	128	8	23	128	0
STR 3/ 199	505	59	-1	76	-12	12	4	9	8	6	5	10	8	7	6	10	10	59	5	11	59	0
															Maximum/Minimum Strength 1 & 3 Cases =	41	41	268	-2	44		-2

File: Bolt Forces_All Locations_Pylon_Main Span Side_9.30.2016.xls
Tab: Pylon Conn._M505

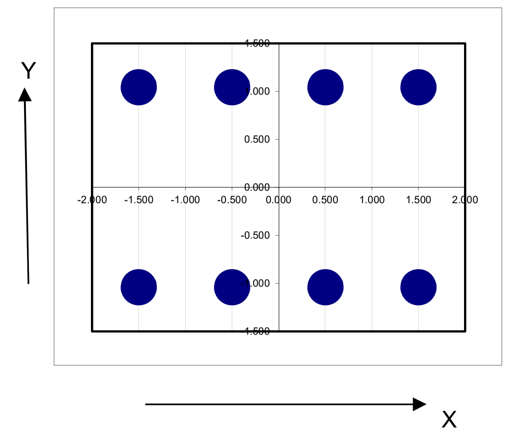
FIGG	Project: FIU Pedestrian Bridge	Date: 08/03/16	Page of
	Project No.: 2262.03	Designed: EDL	
	Description: Bolt Geometry	Checked: MF	

Upper Pylon - Bolted Connections

1) Geometry

1.375 in diameter bolt

Bolt	x (ft)	y (ft)	x^2	y^2	S_x	S_y
1	-1.500	1.042	2.250	1.085	0.12	-0.15
2	-0.500	1.042	0.250	1.085	0.12	-0.05
3	0.500	1.042	0.250	1.085	0.12	0.05
4	1.500	1.042	2.250	1.085	0.12	0.15
5	-1.500	-1.042	2.250	1.085	-0.12	-0.15
6	-0.500	-1.042	0.250	1.085	-0.12	-0.05
7	0.500	-1.042	0.250	1.085	-0.12	0.05
8	1.500	-1.042	2.250	1.085	-0.12	0.15
9			0.000	0.000	0.00	0.00
10			0.000	0.000	0.00	0.00
11			0.000	0.000	0.00	0.00
12			0.000	0.000	0.00	0.00



Σx^2 **10.00**

Σy^2 **8.68**

N = **8** number of bolts

Pipe Connection Design - ACI Chapter 17

Part I. Check Pylon Connection (Member 501) - Tension:

Ultimate Loads (from AASHTO STR I & STR III Load Combinations):

$T_{u\_bolt} := 93\text{kips}$	Maximum Bolt Tensile Force - Strength Cases
$T_{u\_bolt2} := 93\text{kips}$	Max Corner Bolt Tensile Force - Strength Cases
$T_{u\_bolttotal} := 198\text{kips}$	Max Sum of All Bolt Tensile Forces - Strength Cases
$V_{u\_bolt} := 14\text{kips}$	Concurrent Bolt Shear Force - Strength Cases

Materials Properties and Resistance Factor:

$f'_c := 8500 \cdot \text{psi}$	Concrete Strength
$\phi_{anchor} := 0.70$	Resistance Factor for ACI Section 9.2 Combinations (for anchor governed by concrete breakout, side-face blowout, pullout, or pryout strength)

Bolt Properties & Geometry:

$N_{bolt} := 8$	Number of Bolts
$N_{bolt\_corner} := 1$	Number of Grouped Corner Bolts
$d_a := 1.375 \cdot \text{in}$	Bolt Diameter
$A_{sen} := 1.16 \cdot \text{in}^2$	Effective Area of the Anchor assuming coarse threaded bolt per PCA Notes Table 34-2
$F_{ya} := 105000 \cdot \text{psi}$	Yield Strength of Anchor (for 1 - 3/8" diameter F1554 bolts - Grade 105)
$F_{ut} := 125000 \cdot \text{psi}$	Min. tensile strength for design
$F_{uta} := \min(1.9 \cdot F_{ya}, 125 \cdot \text{ksi}, F_{ut})$	Ultimate tensile strength per ACI 17.4.1.1
$F_{uta} = 125.00 \cdot \text{ksi}$	
$h_{ef} := 21 \cdot \text{in}$	Effective Embedment Length
$c_{a1} := 17.5 \cdot \text{in}$	Transverse Edge Distance to Corner Bolt
$S_1 := 25\text{in}$	Spacing Between Bolts - Transverse
$S_2 := 12\text{in}$	Spacing Between Bolts - Longitudinal

Pipe Connection Design

a) Steel Strength Check ACI 17.4.1 - Check Tensile Capacity of 1 Bolt

$\phi_{steel} := 0.75$

Resistance factor for anchor governed by strength of ductile steel element - ACI 17.3.3a

$\phi N_{sa} := \phi_{steel} \cdot A_{sen} \cdot F_{uta}$

$\phi N_{sa} = 108.75 \cdot kips$

$$CHECK\_Steel\_Strength := \begin{cases} \text{"OKAY"} & \text{if } (\phi N_{sa} \geq T_{u\_bolt}) \\ \text{"NG"} & \text{otherwise} \end{cases}$$

Strength Cases

CHECK_Steel_Strength = "OKAY"

b) Concrete Breakout Strength ACI 17.4.2

Determine A_{nc} and A_{nco} according to ACI 17.4.2.1:

By inspection, worst case occurs when corner bolt is in tension. The failure surface is defined by 1.5 h_{ef} from the corner bolt in both directions.

$A_{nc} := [2 \cdot (1.5 \cdot h_{ef})] \cdot ((c_{a1} + 1.5 h_{ef}))$

$A_{nc} = 3087.00 \cdot in^2$

$A_{nco} := 9 \cdot h_{ef}^2$

$A_{nco} = 3969.00 \cdot in^2$

Projected area of 35 degree failure plane

$$CHECK\_Areas := \begin{cases} \text{"OKAY"} & \text{if } (A_{nco} \cdot N_{bolt\_corner} \geq A_{nc}) \\ \text{"NG"} & \text{otherwise} \end{cases}$$

CHECK_Areas = "OKAY"

Pipe Connection Design

Calculate concrete breakout strength

$\varphi_{ecN} := 1.0$ Factor accounts for No eccentricity in the connection

$\varphi_{edN} := 0.7 + 0.3 \cdot \dfrac{\min(c_{a1})}{1.5 h_{ef}}$ Factor accounts for location of the anchor near a free edge

$\varphi_{edN} = 0.87$

$\varphi_{cN} := 1.25$ Factor for cast-in-place anchors

$\varphi_{cpN} := 1.0$ Modification factor for cast-in anchors

$k_c := 24$ For cast-in anchor

$\lambda := 1.0$ Normal weight concrete

$N_{b1} := k_c \cdot \lambda \cdot \sqrt{\dfrac{f'_c}{psi}} \cdot \left(\dfrac{h_{ef}}{in}\right)^{1.5}$ Basic concrete breakout strength of a single anchor in tension

$N_{b1} = 212936$ lbs

$N_{bmax} := 16 \cdot \lambda \cdot \sqrt{\dfrac{f'_c}{psi}} \cdot \left(\dfrac{h_{ef}}{in}\right)^{\left(\frac{5}{3}\right)}$ Nb max for cast-in headed studs and headed bolts with h_{ef} >11in and <25in

$N_{bmax} = 235791.57$ lbs

$N_b := \min(N_{b1}, N_{bmax})$

$N_b = 212936.27$ lbs

$N_{cb} := \dfrac{A_{nc}}{A_{nco}} \cdot \varphi_{edN} \cdot \varphi_{cN} \cdot \varphi_{cpN} \cdot \dfrac{N_b}{1000}$ Nominal concrete Breakout strength for a single anchor

$N_{cb} = 179.42$ kips

$\phi_{anchor} \cdot N_{cb} = 125.59$ kips

$$\text{CHECK\_}\phi\text{Ncbg\_capacity} := \begin{cases} \text{"OKAY"} & \text{if } \left(\phi_{anchor} \cdot N_{cb} \geq \dfrac{T_{u\_bolt2}}{kips}\right) \\ \text{"ADD REINF"} & \text{otherwise} \end{cases}$$ Strength Cases

CHECK_ϕNcbg_capacity = **"OKAY"**

Pipe Connection Design

c) Pullout Strength ACI 17.4.3

$\varphi_{cp} := 1.0$ — Factor for pullout strength ACI 17.4.3.6

$A_{brg} := 2.199 \cdot in^2$ — Conservatively assume regular Hex nut Abrg per PCA Notes Table 34-2

$N_p := 8 \cdot (A_{brg} \cdot f'_c)$ — Pullout strength in tension of a single headed bolt

$N_p = 149.53 \cdot kips$

$\phi N_{pn} := \phi_{anchor} \cdot \varphi_{cp} \cdot N_p$ — Nominal Pullout strength of a single bolt

$\phi N_{pn} = 104.67 \cdot kips$

$$CHECK\_\phi N_{pn} := \begin{cases} \text{"OKAY"} & \text{if } (\phi N_{pn} \geq T_{u\_bolt}) \\ \text{"NG"} & \text{otherwise} \end{cases}$$

Compare to maximum bolt tensile load in the group (Strength Cases)

$CHECK\_\phi N_{pn} = \text{"OKAY"}$

Pipe Connection Design

d) Side-Face Blowout ACI 17.4.4

$$\text{Check\_Sidefaceblowout} := \begin{cases} \textbf{"OKAY"} & \text{if } h_{ef} \le \mathbf{2.5} \cdot c_{a1} \\ \textbf{"CHECK BLOWOUT"} & \text{otherwise} \end{cases}$$

$$\text{Check\_Sidefaceblowout} = \textbf{"OKAY"}$$

Note: Calculation of Side-Face Blowout Strength is not required since $h_{ef} < 2.5 * c_{a1}$.

$$N_{sb} := \mathbf{160} \cdot \frac{c_{a1}}{in} \cdot \sqrt{\frac{A_{brg}}{in^{\mathbf{2}}}} \cdot \lambda \cdot \sqrt{\frac{f'_c}{psi}}$$

$$N_{sb} = \mathbf{382807.21} \text{ lbs}$$

$$\text{Factor} := \mathbf{1.0}$$

Factor does not apply since $S_{edge\_long} > 3 * S_{edge\_trans}$

$$\phi N_{sb} := \phi_{anchor} \cdot \frac{N_{sb}}{\mathbf{1000}} \cdot \text{Factor}$$

$$\phi N_{sb} = \mathbf{267.97} \text{ kips}$$

Nominal Pullout strength of a single bolt

$$\text{CHECK\_}\phi\text{Nsb\_capacity} := \begin{cases} \textbf{"OKAY"} & \text{if } \left(\phi N_{sb} \ge \frac{T_{u\_bolt}}{kips} \right) \\ \textbf{"NG"} & \text{otherwise} \end{cases}$$

Strength Cases

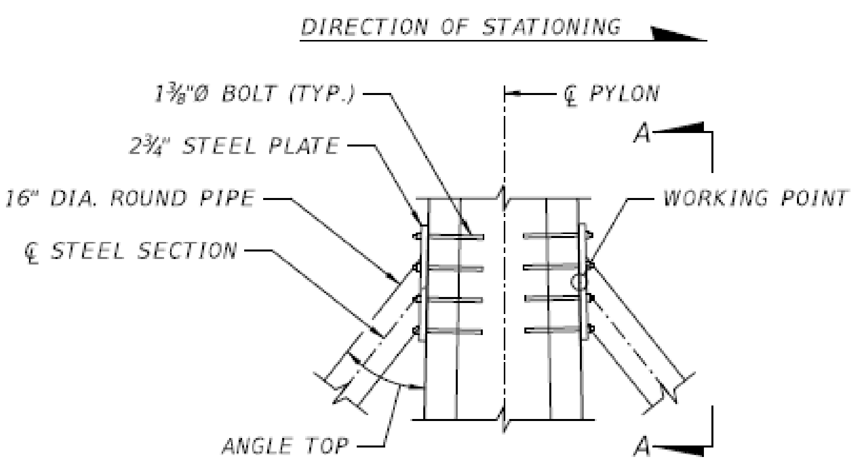
$$\text{CHECK\_}\phi\text{Nsb\_capacity} = \textbf{"OKAY"}$$

Pipe Connection Design

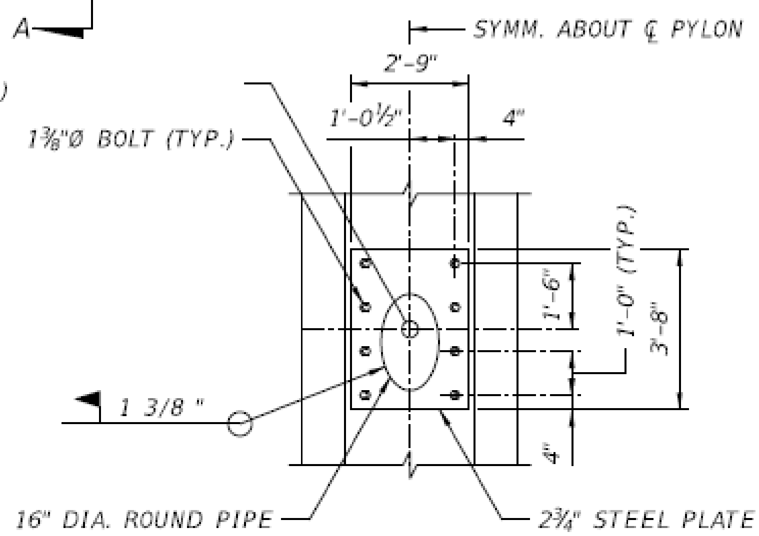
Summary of design strengths based on steel strength, concrete breakout strength, and pullout strength:

Steel Strength (per bolt):	$\phi N_{sa} = \mathbf{108.75} \cdot kips$
Embedment Strength - Concrete breakout (one bolt):	$\phi_{anchor} \cdot N_{cb} = \mathbf{125.59}$ kips
Embedment Strength - Pullout (per bolt):	$\phi N_{pn} = \mathbf{104.67} \cdot kips$

$\phi N_n := \min(\phi N_{sa}, \phi_{anchor} \cdot N_{cb} \cdot kips, \phi N_{pn})$ $\quad\quad \boxed{\phi N_n = \mathbf{104.67} \cdot kips}$



DETAIL A
(UPPER CONNECTION)



Pylon Connection Design

Part II. Check Connection - Shear:

a) Steel strength ACI 17.5.1

$\phi_{shear} := \mathbf{0.65}$ — Shear Resistance Factor for anchor governed by ductile element - ACI 17.3.3a

$RF := \mathbf{1.0}$ (No built-up grout pad) — Reduction factor for built-up grout pads

$V_{sa} := 0.6 A_{sen} \cdot F_{uta} \cdot RF$ — Shear Strength for cast-in headed bolt

$V_{sa} = \mathbf{87.00} \cdot kips$

$\phi_{shear} \cdot V_{sa} = \mathbf{56.55} \cdot kips$

$CHECK\_\phi Vsa\_capacity := \begin{cases} \text{"OKAY"} & \text{if } \left(\phi_{shear} \cdot V_{sa} \geq V_{u\_bolt}\right) \\ \text{"NG"} & \text{otherwise} \end{cases}$ — Strength Cases

$CHECK\_\phi Vsa\_capacity = \text{"OKAY"}$

b) Concrete breakout strength ACI 17.5.2

By inspection, longitudinal shear will control. Investigate corner connection for shear on one bolt.

$S_{edge\_trans} := \mathbf{17.5} in$ — Transverse edge distance

$h_a := \mathbf{4} \cdot ft + \mathbf{11} in$ — Pylon length where maximum shear occurs

$A_{vc} := \left(2 \cdot \mathbf{1.5} S_{edge\_trans}\right) \cdot h_a$ — $A_{vc} = \mathbf{3097.50} \cdot in^2$

$A_{vco} := \mathbf{4.5} \cdot S_{edge\_trans}^{\ \ 2}$ — $A_{vco} = \mathbf{1378.13} \cdot in^2$

$\varphi_{ecv} := \mathbf{1.0}$ — Factor for shear eccentricity

$\varphi_{edv} := \mathbf{1.0}$ — Factor for edge-effect when $S_{edge\_long} > 1.5\ S_{edge\_trans}$

Pylon Connection Design

b) Concrete breakout strength ACI 17.5.2 (continued)

$\varphi_{cv} := \mathbf{1.4}$ — Factor for no cracking at service loads

$\varphi_{hv} := \max\left(\sqrt{\mathbf{1.5}\cdot\frac{S_{edge\_trans}}{h_a}}, \mathbf{1}\right)$ — Factor for member thickness

$\varphi_{hv} = \mathbf{1.00}$

$l_e := \min(h_{ef}, \mathbf{8}\cdot d_a)$ — Limitation of 8da on maximum le allowed

$l_e = \mathbf{11.00}\cdot in$

$$V_{b1} := \mathbf{7}\left(\frac{l_e}{d_a}\right)^{\mathbf{0.2}}\cdot\sqrt{\frac{d_a}{in}}\cdot\lambda\cdot\sqrt{\frac{f'_c}{psi}}\cdot\left(\frac{S_{edge\_trans}}{in}\right)^{\mathbf{1.5}}$$

Basic Concrete breakout Strength - ACI 17.5.2.2a

$V_{b1} = \mathbf{83971.89}$ lbs

$$V_{b2} := \mathbf{9}\cdot\lambda\cdot\sqrt{\frac{f'_c}{psi}}\cdot\left(\frac{S_{edge\_trans}}{in}\right)^{\mathbf{1.5}}$$

Basic Concrete breakout Strength - ACI 17.5.2.2b

$V_{b2} = \mathbf{60744.79}$ lbs

$V_b := \min(V_{b1}, V_{b2}) = \mathbf{60744.79}$ lbs

$$V_{cb} := \phi_{anchor}\cdot\frac{A_{vc}}{A_{vco}}\cdot\varphi_{edv}\cdot\varphi_{cv}\cdot\varphi_{hv}\cdot\frac{V_b}{\mathbf{1000}}$$

$V_{cb} = \mathbf{133.80}$ kips

$$\text{CHECK\_}\phi\text{Vcbg\_capacity} := \begin{cases} \textbf{"OKAY"} & \text{if } \left(V_{cb} \ge N_{bolt\_corner}\cdot\frac{V_{u\_bolt}}{kips}\right) \\ \textbf{"NG"} & \text{otherwise} \end{cases}$$

Strength Cases

CHECK_ϕVcbg_capacity = **"OKAY"**

Pylon Connection Design

c) Concrete pryout strength of anchor in shear ACI 17.5.3

$k_{cp} := \mathbf{2.0}$ Modification Factor for $h_{ef} > 2.5\text{in}$

$V_{cp} := k_{cp} \cdot N_{cb}$

$V_{cp} = \mathbf{358.84}$ kips

$$\text{CHECK\_}\phi\text{Vcp\_capacity} := \begin{cases} \textbf{"OKAY"} & \text{if } \left(\phi_{shear} \cdot V_{cp} \ge \dfrac{N_{bolt\_corner} \cdot V_{u\_bolt}}{\text{kips}}\right) \\ \textbf{"NG"} & \text{otherwise} \end{cases}$$

$\text{CHECK\_}\phi\text{Vcp\_capacity} = \textbf{"OKAY"}$

Summary of design strengths based on steel strength, concrete breakout strength, and pryout strength:

Steel Strength (per bolt): $\phi_{shear} \cdot V_{sa} = \mathbf{56.55} \cdot \text{kips}$

Embedment Strength - Concrete breakout (3 bolts): $V_{cb} = \mathbf{133.80}$ kips

Embedment Strength - Pryout (per bolt): $\phi_{shear} \cdot V_{cp} = \mathbf{233.24}$ kips

$\phi V_n := \min\left(\phi_{shear} \cdot V_{cp} \cdot \text{kips}, \phi_{shear} \cdot V_{sa}\right)$ $\boxed{\phi V_n = \mathbf{56.55} \cdot \text{kips}}$

Pylon Connection Design

d) Interaction of tensile and shear force ACI 17.6

Strength Cases:

CHECK_ultimate_shear := | **"Full Strength in Tension shall be permitted"** if $(\mathbf{0.2} \cdot \phi V_n \geq V_{u\_bolt})$
| **"Use Eq. 17.6.3"** otherwise

CHECK_ultimate_shear = **"Use Eq. 17.6.3"**

CHECK_ultimate_tension := | **"Full Strength in Shear shall be permitted"** if $(\mathbf{0.2} \cdot \phi N_n \geq T_{u\_bolt})$
| **"Use Eq. 17.6.3"** otherwise

CHECK_ultimate_tension = **"Use Eq. 17.6.3"**

$$\frac{T_{u\_bolt}}{\phi N_n} + \frac{V_{u\_bolt}}{\phi V_n} = \mathbf{1.14}$$

ACI 17.6.3 Eq.

CHECK_ultimate_interaction := | **"OK"** if $\left(\mathbf{1.2} \geq \frac{T_{u\_bolt}}{\phi N_n} + \frac{V_{u\_bolt}}{\phi V_n}\right)$
| **"NG"** otherwise

CHECK_ultimate_interaction = **"OK"**

Pylon Connection Design

Part III. Base Plate Design

a) Bearing Stress per AASHTO LRFD 5.7.5

Assume that the bearing plate is in full contact with the pylon.

Calculate Contact Stress:

$P_u := 467\text{kips}$ — Maximum sum of bolts in compression (all load cases)

$B_{plate} := 2\text{ft} + 9\text{in}$ — Width of Plate

$N_{plate} := 3\text{ft} + 8\text{in}$ — Length of Plate

$$A_1 := \left[\left(\frac{B_{plate}}{2}\right)\cdot\frac{N_{plate}}{2}\right]$$

Provided Area of bearing plate assuming 1/4 of the plate is in compression (1/2 the plate due to long. moment - 1/2 the plate due to trans moment)

$A_1 = 363.00\cdot\text{in}^2$

$f_c := 8.5\text{ksi}$ — Pylon Concrete Compressive Strength

$m := 1$ — Conservatively assume m = 1 (A1=A2)

$P_n := 0.85\cdot f_c\cdot A_1\cdot m$

$P_n = 2622.68\cdot\text{kips}$

$\phi_{bearing} := 0.70$ — Resistance factor per AASHTO LRFD 5.5.4.2

$\phi P_n := \phi_{bearing}\cdot P_n$

$\phi P_n = 1835.87\cdot\text{kips}$

$$\text{CHECK\_Bearing} := \begin{cases} \text{"OKAY"} & \text{if } (\phi P_n \geq P_u) \\ \text{"NG"} & \text{otherwise} \end{cases}$$

CHECK_Bearing = "OKAY"

b) Plate thickness - Check bending

$P_{u\_t1} := 152 kips$ Bolt forces in compression within critical section (all load cases)

$P_{u\_t2} := 102 kips$

$d_1 := 11 in$ Distance from centroid of bolts to critical section

$d_2 := 2.0 in$

$M_u := P_{u\_t1} \cdot d_1 + P_{u\_t2} \cdot d_2$ Factored plate moment

$M_u = 156.33 \cdot kips \cdot ft$

$t := 2.75 in$ Assumed plate thickness

$l_{critical} := 33.375 in$ Length of critical section

$$Z := \frac{l_{critical} \cdot t^2}{4}$$

$Z = 63.10 \cdot in^3$

$f_{ys} := 36 ksi$ Use 36ksi steel for base plates

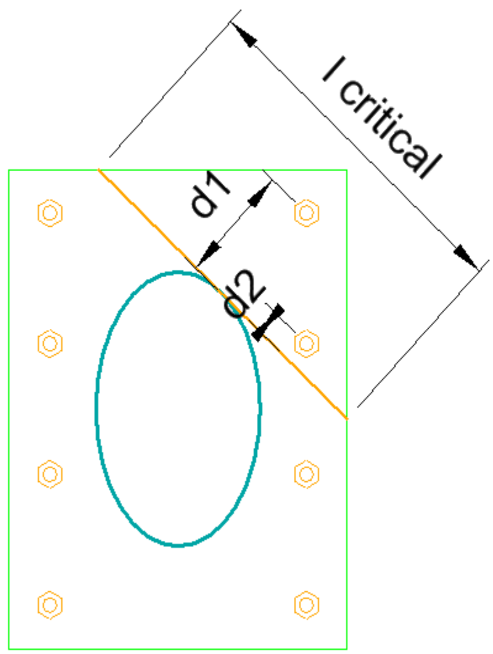
$\phi_{bending} := 1.0$ AASHTO LRFD 6.5.4.2

$\phi M_n := \phi_{bending} \cdot Z \cdot f_{ys}$

$\phi M_n = 189.30 \cdot kips \cdot ft$

$$CHECK\_Plate := \begin{cases} \text{"OKAY"} & \text{if } (\phi M_n \geq M_u) \\ \text{"NG"} & \text{otherwise} \end{cases}$$

$CHECK\_Plate = \text{"OKAY"}$



Due to large longitudinal bending, also check additional possible critical section with the two outer bolts in compression

Pylon Connection Design

$P_{u\_t3} := 273\text{kips}$ Maximum sum of bolts in compression (all load cases)

$d_3 := 5.0\text{in}$ Distance from centroid of 2 outside bolts to critical section

$M_{u2} := P_{u\_t3} \cdot d_3$

$M_{u2} = 113.75 \cdot \text{kips} \cdot \text{ft}$ Factored plate moment

$t := 2.75\text{in}$ Assumed plate thickness

$l_{critical\_2} := 33\text{in}$ Length of critical section

$$Z_2 := \frac{l_{critical\_2} \cdot t^2}{4}$$

$Z_2 = 62.39 \cdot \text{in}^3$

$f_{ys} := 36\text{ksi}$ Use 36ksi steel for base plates

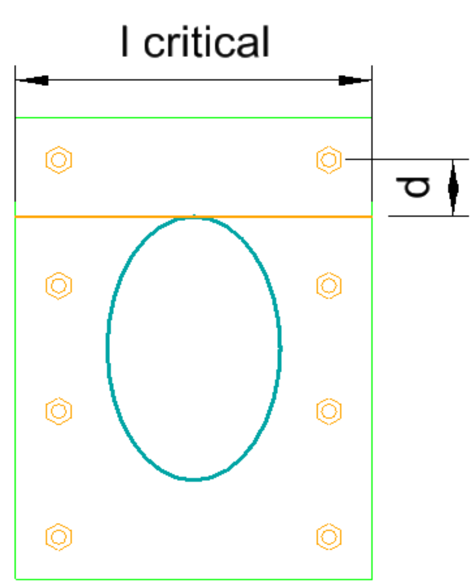
$\phi_{bending} := 1.0$ AASHTO 6.5.4.2

$\phi M_{n2} := \phi_{bending} \cdot Z_2 \cdot f_{ys}$

$\phi M_{n2} = 187.17 \cdot \text{kips} \cdot \text{ft}$

$$CHECK\_Plate := \begin{vmatrix} \text{"OKAY"} & \text{if } (\phi M_{n2} \geq M_{u2}) \\ \text{"NG"} & \text{otherwise} \end{vmatrix}$$

$CHECK\_Plate = \text{"OKAY"}$



Use 2 3/4" Thick Plate

Pylon Connection Design

Part IV. Check Weld Design per AASHTO LRFD:

Check weld between pipe and base plate:

$V_{umax} := \mathbf{348} kips$	Maximum combined shear on pylon (Member 505)
$F_{exx} := \mathbf{70} \cdot ksi$	Classfication tensile strength of the weld metal
$a := \frac{\mathbf{3}}{\mathbf{8}} in$	Weld size
$t_e := \mathbf{0.707} \cdot a$	Effective throat dimension
$t_e = \mathbf{0.27} \cdot in$	
$Circ := \mathbf{5.8125} ft$	Perimeter of the weld - measured in Microstation
$\phi_{e1} := \mathbf{0.85}$	AASHTO 6.5.4.2
$R_r := \mathbf{0.60} \cdot \phi_{e1} \cdot F_{exx}$	AASHTO 6.13.3.2.2b-1
$R_r = \mathbf{5140.80} \cdot ksf$	
$V_{weld} := R_r \cdot Circ \cdot t_e$	
$V_{weld} = \mathbf{660.2} \cdot kips$	

$$CHECK\_Weld := \begin{cases} \textbf{"OKAY"} & \text{if } (V_{weld} \geq V_{umax}) \\ \textbf{"NG"} & \text{otherwise} \end{cases}$$

$CHECK\_Weld = \textbf{"OKAY"}$

Pipe Connection Design - ACI Chapter 17

Part I. Check Pylon Connection (Member 505) - Tension:

Ultimate Loads (from AASHTO STR I & STR III Load Combinations):

$T_{u\_bolt} := \mathbf{41}\text{kips}$	Maximum Bolt Tensile Force - Strength Cases
$T_{u\_bolt2} := \mathbf{41}\text{kips}$	Max Corner Bolt Tensile Force - Strength Cases
$T_{u\_bolttotal} := \mathbf{268}\text{kips}$	Max Sum of All Bolt Tensile Forces - Strength Cases
$V_{u\_bolt} := \mathbf{44}\text{kips}$	Maximum Bolt Shear Force - Strength Cases

Materials Properties and Resistance Factor:

$f'_c := \mathbf{8500} \cdot \text{psi}$	Concrete Strength
$\phi_{anchor} := \mathbf{0.70}$	Resistance Factor for ACI Section 9.2 Combinations (for anchor governed by concrete breakout, side-face blowout, pullout, or pryout strength)

Bolt Properties & Geometry:

$N_{bolt} := \mathbf{8}$	Number of Bolts
$N_{bolt\_corner} := \mathbf{1}$	Number of Grouped Corner Bolts
$d_a := \mathbf{1.375} \cdot \text{in}$	Bolt Diameter
$A_{sen} := \mathbf{1.16} \cdot \text{in}^2$	Effective Area of the Anchor assuming coarse threaded bolt per PCA Notes Table 34-2
$F_{ya} := \mathbf{105000} \cdot \text{psi}$	Yield Strength of Anchor (for 1 - 3/8" diameter F1554 bolts - Grade 105)
$F_{ut} := \mathbf{125000} \cdot \text{psi}$	Min. tensile strength for design
$F_{uta} := \min(1.9 \cdot F_{ya}, \mathbf{125} \cdot \text{ksi}, F_{ut})$	Ultimate tensile strength per ACI 17.4.1.1
$F_{uta} = \mathbf{125.00} \cdot \text{ksi}$	
$h_{ef} := \mathbf{21} \cdot \text{in}$	Effective Embedment Length
$c_{a1} := \mathbf{17.5} \cdot \text{in}$	Transverse Edge Distance to Corner Bolt
$S_1 := \mathbf{25}\text{in}$	Spacing Between Bolts - Transverse
$S_2 := \mathbf{12}\text{in}$	Spacing Between Bolts - Longitudinal

Pipe Connection Design

a) Steel Strength Check ACI 17.4.1 - Check Tensile Capacity of 1 Bolt

$\phi_{steel} := 0.75$

Resistance factor for anchor governed by strength of ductile steel element - ACI 17.3.3a

$\phi N_{sa} := \phi_{steel} \cdot A_{sen} \cdot F_{uta}$

$\phi N_{sa} = 108.75 \cdot kips$

$$CHECK\_Steel\_Strength := \begin{vmatrix} \text{"OKAY"} & \text{if } \left(\phi N_{sa} \geq T_{u\_bolt}\right) \\ \text{"NG"} & \text{otherwise} \end{vmatrix}$$

Strength Cases

CHECK_Steel_Strength = "OKAY"

b) Concrete Breakout Strength ACI 17.4.2

Determine A_{nc} and A_{nco} according to ACI 17.4.2.1:

By inspection, worst case occurs when corner bolt is in tension. The failure surface is defined by 1.5 h_{ef} from the corner bolt in both directions.

$A_{nc} := \left[2 \cdot \left(1.5 \cdot h_{ef}\right)\right] \cdot \left(\left(c_{a1} + 1.5 h_{ef}\right)\right)$

$A_{nc} = 3087.00 \cdot in^2$

$A_{nco} := 9 \cdot h_{ef}^2$

$A_{nco} = 3969.00 \cdot in^2$

Projected area of 35 degree failure plane

$$CHECK\_Areas := \begin{vmatrix} \text{"OKAY"} & \text{if } \left(A_{nco} \cdot N_{bolt\_corner} \geq A_{nc}\right) \\ \text{"NG"} & \text{otherwise} \end{vmatrix}$$

CHECK_Areas = "OKAY"

Pipe Connection Design

Calculate concrete breakout strength

$\varphi_{ecN} := 1.0$ Factor accounts for No eccentricity in the connection

$\varphi_{edN} := 0.7 + 0.3 \cdot \frac{\min(c_{a1})}{1.5 h_{ef}}$ Factor accounts for location of the anchor near a free edge

$\varphi_{edN} = 0.87$

$\varphi_{cN} := 1.25$ Factor for cast-in-place anchors

$\varphi_{cpN} := 1.0$ Modification factor for cast-in anchors

$k_c := 24$ For cast-in anchor

$\lambda := 1.0$ Normal weight concrete

$N_{b1} := k_c \cdot \lambda \cdot \sqrt{\frac{f'_c}{psi}} \cdot \left(\frac{h_{ef}}{in}\right)^{1.5}$ Basic concrete breakout strength of a single anchor in tension

$N_{b1} = 212936$ lbs

$N_{bmax} := 16 \cdot \lambda \cdot \sqrt{\frac{f'_c}{psi}} \cdot \left(\frac{h_{ef}}{in}\right)^{\left(\frac{5}{3}\right)}$ $N_{b\ max}$ for cast-in headed studs and headed bolts with h_{ef} >11in and <25in

$N_{bmax} = 235791.57$ lbs

$N_b := \min(N_{b1}, N_{bmax})$

$N_b = 212936.27$ lbs

$N_{cb} := \frac{A_{nc}}{A_{nco}} \cdot \varphi_{edN} \cdot \varphi_{cN} \cdot \varphi_{cpN} \cdot \frac{N_b}{1000}$ Nominal concrete Breakout strength for a single anchor

$N_{cb} = 179.42$ kips

$\phi_{anchor} \cdot N_{cb} = 125.59$ kips

CHECK_ϕNcbg_capacity := | "OKAY" if $\left(\phi_{anchor} \cdot N_{cb} \geq \frac{T_{u\_bolt2}}{kips}\right)$
| "ADD REINF" otherwise

Strength Cases

CHECK_ϕNcbg_capacity = "OKAY"

Pipe Connection Design

c) Pullout Strength ACI 17.4.3

$\varphi_{cp} := 1.0$ — Factor for pullout strength ACI 17.4.3.6

$A_{brg} := 2.199 \cdot in^2$ — Conservatively assume regular Hex nut Abrg per PCA Notes Table 34-2

$N_p := 8 \cdot (A_{brg} \cdot f'_c)$ — Pullout strength in tension of a single headed bolt

$N_p = 149.53 \cdot kips$

$\phi N_{pn} := \phi_{anchor} \cdot \varphi_{cp} \cdot N_p$ — Nominal Pullout strength of a single bolt

$\phi N_{pn} = 104.67 \cdot kips$

$CHECK\_\phi N_{pn} := \begin{cases} \text{"OKAY"} & \text{if } (\phi N_{pn} \ge T_{u\_bolt}) \\ \text{"NG"} & \text{otherwise} \end{cases}$ — Compare to maximum bolt tensile load (Strength Cases)

$CHECK\_\phi N_{pn} = \text{"OKAY"}$

Pipe Connection Design

d) Side-Face Blowout ACI 17.4.4

$$\text{Check\_Sidefaceblowout} := \begin{cases} \textbf{"OKAY"} & \text{if } h_{ef} \le \mathbf{2.5} \cdot c_{a1} \\ \textbf{"CHECK BLOWOUT"} & \text{otherwise} \end{cases}$$

$$\text{Check\_Sidefaceblowout} = \textbf{"OKAY"}$$

Note: Calculation of Side-Face Blowout Strength is not required since $h_{ef} < 2.5 * c_{a1}$.

$$N_{sb} := \mathbf{160} \cdot \frac{c_{a1}}{in} \cdot \sqrt{\frac{A_{brg}}{in^{\mathbf{2}}}} \cdot \lambda \cdot \sqrt{\frac{f'_c}{psi}}$$

$$N_{sb} = \mathbf{382807.21} \ \text{lbs}$$

$$\text{Factor} := \mathbf{1.0}$$

Factor does not apply since $S_{edge\_long} > 3 * S_{edge\_trans}$

$$\phi N_{sb} := \phi_{anchor} \cdot \frac{N_{sb}}{\mathbf{1000}} \cdot \text{Factor}$$

$$\phi N_{sb} = \mathbf{267.97} \ \text{kips}$$

Nominal Pullout strength of a single bolt

$$\text{CHECK\_}\phi\text{Nsb\_capacity} := \begin{cases} \textbf{"OKAY"} & \text{if } \left(\phi N_{sb} \ge \frac{T_{u\_bolt}}{kips} \right) \\ \textbf{"NG"} & \text{otherwise} \end{cases}$$

Strength Cases

$$\text{CHECK\_}\phi\text{Nsb\_capacity} = \textbf{"OKAY"}$$

Pipe Connection Design

Summary of design strengths based on steel strength, concrete breakout strength, and pullout strength:

Steel Strength (per bolt):	$\phi N_{sa} = \mathbf{108.75} \cdot kips$
Embedment Strength - Concrete breakout (one bolt):	$\phi_{anchor} \cdot N_{cb} = \mathbf{125.59}$ kips
Embedment Strength - Pullout (per bolt):	$\phi N_{pn} = \mathbf{104.67} \cdot kips$

$\phi N_n := \min\left(\phi N_{sa}, \phi_{anchor} \cdot N_{cb} \cdot kips, \phi N_{pn}\right)$ $\boxed{\phi N_n = \mathbf{104.67} \cdot kips}$

Pylon Connection Design

Part II. Check Connection - Shear:

a) Steel strength ACI 17.5.1

$\phi_{shear} := 0.65$ — Shear Resistance Factor for anchor governed by ductile element - ACI 17.3.3a

$RF := 1.0$ (No built-up grout pad) — Reduction factor for built-up grout pads

$V_{sa} := 0.6A_{sen} \cdot F_{uta} \cdot RF$ — Shear Strength for cast-in headed bolt

$V_{sa} = 87.00 \cdot kips$

$\phi_{shear} \cdot V_{sa} = 56.55 \cdot kips$

$CHECK\_\phi Vsa\_capacity := \begin{cases} \text{"OKAY"} & \text{if } (\phi_{shear} \cdot V_{sa} \geq V_{u\_bolt}) \\ \text{"NG"} & \text{otherwise} \end{cases}$ — Strength Cases

$CHECK\_\phi Vsa\_capacity = \text{"OKAY"}$

b) Concrete breakout strength ACI 17.5.2

By inspection, longitudinal shear will control. Investigate corner connection for shear on one bolt.

$S_{edge\_trans} := 17.5in$ — Transverse edge distance

$h_a := 4 \cdot ft + 11in$ — Pylon length where maximum shear occurs

$A_{vc} := (2 \cdot 1.5S_{edge\_trans}) \cdot h_a$ $\qquad A_{vc} = 3097.50 \cdot in^2$

$A_{vco} := 4.5 \cdot S_{edge\_trans}^{\,2}$ $\qquad A_{vco} = 1378.13 \cdot in^2$

$\varphi_{ecv} := 1.0$ — Factor for shear eccentricity

$\varphi_{edv} := 1.0$ — Factor for edge-effect when $S_{edge\_long} > 1.5\ S_{edge\_trans}$

Pylon Connection Design

b) Concrete breakout strength ACI 17.5.2 (continued)

$\varphi_{cv} := \mathbf{1.4}$ — Factor for no cracking at service loads

$$\varphi_{hv} := \max\left(\sqrt{\mathbf{1.5}\cdot\frac{S_{edge\_trans}}{h_a}}, \mathbf{1}\right)$$

Factor for member thickness

$\varphi_{hv} = \mathbf{1.00}$

$l_e := \min(h_{ef}, \mathbf{8}\cdot d_a)$ — Limitation of $8d_a$ on maximum l_e allowed

$l_e = \mathbf{11.00}\cdot in$

$$V_{b1} := \mathbf{7}\left(\frac{l_e}{d_a}\right)^{\mathbf{0.2}}\cdot\sqrt{\frac{d_a}{in}}\cdot\lambda\cdot\sqrt{\frac{f'_c}{psi}}\cdot\left(\frac{S_{edge\_trans}}{in}\right)^{\mathbf{1.5}}$$

Basic Concrete breakout Strength - ACI 17.5.2.2a

$V_{b1} = \mathbf{83971.89}$ lbs

$$V_{b2} := \mathbf{9}\cdot\lambda\cdot\sqrt{\frac{f'_c}{psi}}\cdot\left(\frac{S_{edge\_trans}}{in}\right)^{\mathbf{1.5}}$$

Basic Concrete breakout Strength - ACI 17.5.2.2b

$V_{b2} = \mathbf{60744.79}$ lbs

$V_b := \min(V_{b1}, V_{b2}) = \mathbf{60744.79}$ lbs

$$V_{cb} := \phi_{anchor}\cdot\frac{A_{vc}}{A_{vco}}\cdot\varphi_{edv}\cdot\varphi_{cv}\cdot\varphi_{hv}\cdot\frac{V_b}{\mathbf{1000}}$$

$V_{cb} = \mathbf{133.80}$ kips

$$CHECK\_\phi Vcbg\_capacity := \begin{cases} \textbf{"OKAY"} & \text{if } \left(V_{cb} \ge N_{bolt\_corner}\cdot\frac{V_{u\_bolt}}{kips}\right) \\ \textbf{"NG"} & \text{otherwise} \end{cases}$$

Strength Cases

$CHECK\_\phi Vcbg\_capacity = \textbf{"OKAY"}$

Pylon Connection Design

c) Concrete pryout strength of anchor in shear ACI 17.5.3

$k_{cp} := \mathbf{2.0}$ Modification Factor for $h_{ef} > 2.5in$

$V_{cp} := k_{cp} \cdot N_{cb}$

$V_{cp} = \mathbf{358.84}$ kips

$$\text{CHECK\_}\phi\text{Vcp\_capacity} := \begin{cases} \textbf{"OKAY"} & \text{if } \left(\phi_{shear} \cdot V_{cp} \geq \dfrac{N_{bolt\_corner} \cdot V_{u\_bolt}}{kips}\right) \\ \textbf{"NG"} & \text{otherwise} \end{cases}$$

$\text{CHECK\_}\phi\text{Vcp\_capacity} = \textbf{"OKAY"}$

Summary of design strengths based on steel strength, concrete breakout strength, and pryout strength:

Steel Strength (per bolt): $\phi_{shear} \cdot V_{sa} = \mathbf{56.55} \cdot kips$

Embedment Strength - Concrete breakout (per bolt): $V_{cb} = \mathbf{133.80}$ kips

Embedment Strength - Pryout (per bolt): $\phi_{shear} \cdot V_{cp} = \mathbf{233.24}$ kips

$\phi V_n := \min\left(\phi_{shear} \cdot V_{sa}, V_{cb} \cdot kips, \phi_{shear} \cdot V_{cp} \cdot kips\right)$ $\boxed{\phi V_n = \mathbf{56.55} \cdot kips}$

Pylon Connection Design

d) Interaction of tensile and shear force ACI 17.6

Strength Cases:

$$\text{CHECK\_ultimate\_shear} := \begin{cases} \textbf{"Full Strength in Tension shall be permitted"} & \text{if } \left(\mathbf{0.2}\cdot\phi V_n \geq V_{u\_bolt}\right) \\ \textbf{"Use Eq. 17.6.3"} & \text{otherwise} \end{cases}$$

$\text{CHECK\_ultimate\_shear} = \textbf{"Use Eq. 17.6.3"}$

$$\text{CHECK\_ultimate\_tension} := \begin{cases} \textbf{"Full Strength in Shear shall be permitted"} & \text{if } \left(\mathbf{0.2}\cdot\phi N_n \geq T_{u\_bolt}\right) \\ \textbf{"Use Eq. 17.6.3"} & \text{otherwise} \end{cases}$$

$\text{CHECK\_ultimate\_tension} = \textbf{"Use Eq. 17.6.3"}$

$$\frac{T_{u\_bolt}}{\phi N_n} + \frac{V_{u\_bolt}}{\phi V_n} = \mathbf{1.17}$$

ACI 17.6.3 Eq.

$$\text{CHECK\_ultimate\_interaction} := \begin{cases} \textbf{"OK"} & \text{if } \left(\mathbf{1.2} \geq \dfrac{T_{u\_bolt}}{\phi N_n} + \dfrac{V_{u\_bolt}}{\phi V_n}\right) \\ \textbf{"NG"} & \text{otherwise} \end{cases}$$

$\text{CHECK\_ultimate\_interaction} = \textbf{"OK"}$

FIGG	Project: FIU	Date: 10-3-16	Page 1 Of 1
	Project Number: 2262.03	Designed: EDL	
	Description: ANCHOR BOLT DESIGN	Checked: MF	

SAMPLE CALCULATIONS (BOLT FORCES SPREADSHEET)

MEMBER 501 @ CANOPY

BOLT TENSION FORCE

STR 3/5 : (+) compression

$$F_{BOLT_8} = \frac{F_z}{\#bolts} + MT \cdot S_X + ML \cdot S_Y$$

$$= \frac{47\,K}{10} + 53\,K \cdot ft\,(-0.12) + (-557\,K \cdot ft)(0.10)$$

$$= 4.7\,K - 6.36\,K - 55.7\,K$$

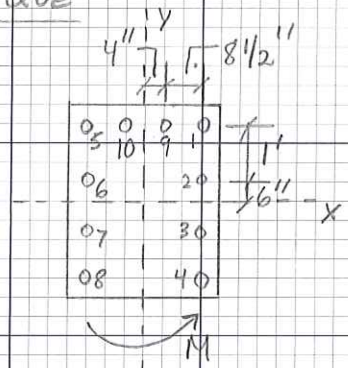
$$F_{BOLT_8} = -59\,K\ (T)$$

Project FIU	Date 10-4-16	Page / Of
Project Number 2262.03	Designed EDL	
Description ANCHOR BOLT DESIGN	Checked MF	

DISTRIBUTION OF FORCES DUE TO TORQUE

M501 - CANOPY

STR 3/119 USING ELASTIC VECTOR METHOD:



TORQUE = $M = 115\ K\cdot ft$

$I_p = \Sigma_i A r_i^2 = \Sigma_i A(x_i^2 + y_i^2)$

$I_p' = \dfrac{I_p}{A}$

$F_{XM} = \dfrac{M y_i}{I_p'}$, $F_{YM} = \dfrac{M x_i}{I_p'}$

$F_{Mi} = \sqrt{(F_{YM} + F_{VLM})^2 + (F_{XM} + F_{VTM})^2}$

$I_p' = (2(4in/12)^2 + 8(12.5in/12)^2) + (4(6in/12)^2 + 2(1.5ft)^2 + 4(1.5ft)^2)$

$I_p' = 8.90\ ft^2 + 14.5\ ft^2 = 23.40\ ft^2$

$F_{XM_1} = \dfrac{115\ K\cdot ft(1.5ft)}{23.40ft^2} = 7.37\ K$

$F_{YM_1} = \dfrac{115\ K\cdot ft(1.042\ ft)}{23.40ft^2} = 5.12\ K$

$F_{VLM} = \dfrac{P}{\Sigma N} = \dfrac{403\ K}{10} = 40.3\ K$ $F_{VTM} = \dfrac{5K}{10} = 0.5K$

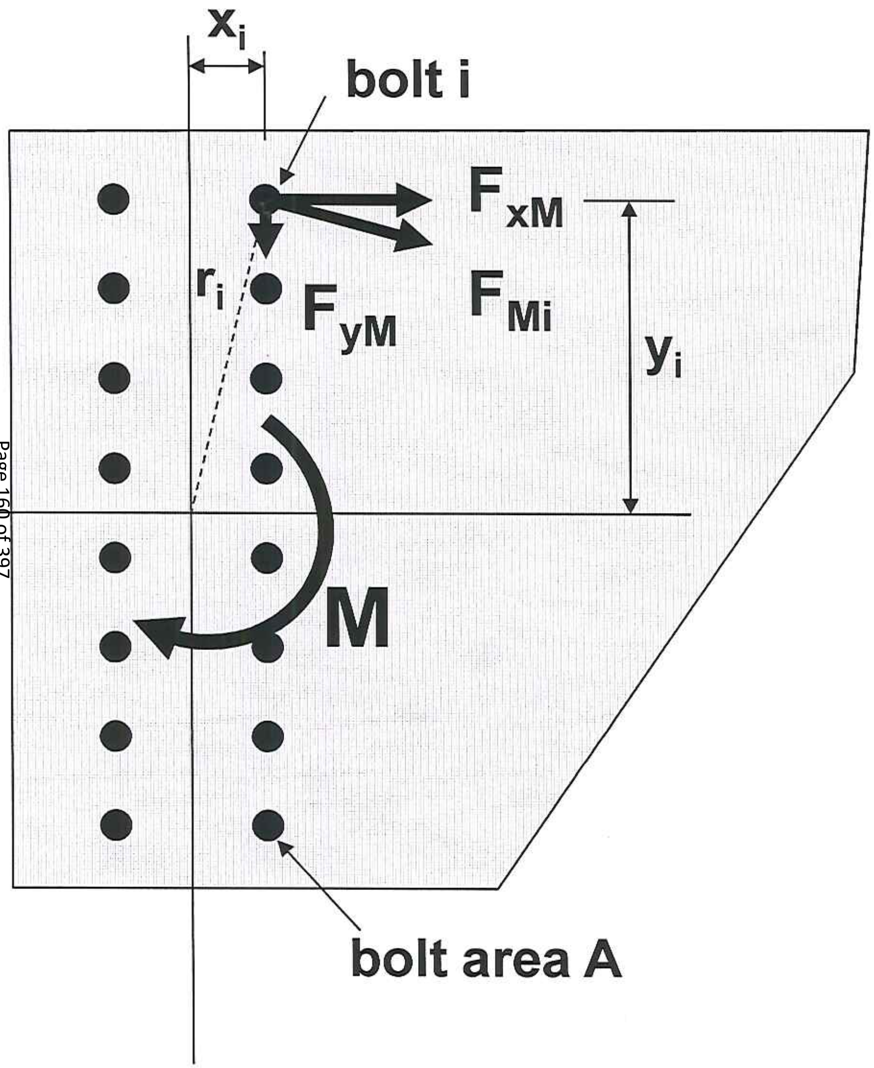
$F_{M_1} = \sqrt{(5.12 + 40.3)^2 + (7.37 + 0.5)^2} = \underline{\underline{46.1\ K}}$

$F_{XM_2} = \dfrac{115\ K\cdot ft(0.5\ ft)}{23.40\ ft^2} = 2.46\ K$

$F_{YM_2} = \dfrac{115\ K\cdot ft(1.042\ ft)}{23.40\ ft^2} = 5.12\ K$

$F_{M_2} = \sqrt{(5.12 + 40.3)^2 + (2.46 + 0.5)^2} = \underline{\underline{45.5\ K}}$

moment



Treat the bolt group as a cross-section subjected to a torsional moment

$$I_p = \Sigma_i\, A\, r_i^2$$
$$= \Sigma_i\, A\, (x_i^2 + y_i^2)$$

and with $I'_P = I_P/A$

$$F_{xM} = M\, y_i \,/\, I'_p$$
$$F_{yM} = M\, x_i \,/\, I'_p$$

$$F_{Mi} = (F_{xM}^2 + F_{yM}^2)^{0.5}$$

Then select a bolt size for the maximum force F_M

Calculation of Shear in Bolts

Usin Elastic Vector Method

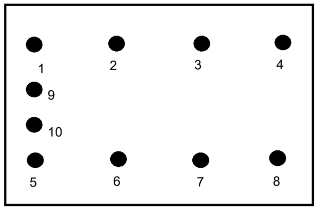
		No. bolts			No. bolts
x_1 (ft)	0.333	2	y_1 (ft)	0.500	4
x_2 (ft)	1.042	8	y_2 (ft)	1.500	6
I'p (ft^2)	23.40				
Total No. Bolts	10				

					Shear										
SUMIT LOAD CASE	MEMBER	VL	VT	Torque	Bolt 1	Bolt 2	Bolt 3	Bolt 4	Bolt 5	Bolt 6	Bolt 7	Bolt 8	Bolt 9	Bolt 10	MAX V
		kips	kips	kip*ft	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	
STR 1/ 155	501	**399**	**0**	**0**	39.88	39.88	39.88	39.88	39.88	39.88	39.88	39.88	39.88	39.88	40
STR 1/ 7	501	**59**	**0**	**7**	6.26	6.24	6.24	6.26	6.26	6.24	6.24	6.26	6.04	6.04	6
STR 1/ 155	501	**399**	**0**	**0**	39.88	39.88	39.88	39.88	39.88	39.88	39.88	39.88	39.88	39.88	40
STR 1/ 9	501	**53**	**0**	**-1**	5.35	5.35	5.35	5.35	5.35	5.35	5.35	5.35	5.33	5.33	5
STR 1/ 101	501	**396**	**0**	**0**	39.61	39.61	39.61	39.61	39.61	39.61	39.61	39.61	39.61	39.61	40
STR 1/ 8	501	**70**	**0**	**8**	7.32	7.30	7.30	7.32	7.32	7.30	7.30	7.32	7.08	7.08	7
STR 1/ 112	501	**63**	**0**	**0**	6.26	6.26	6.26	6.26	6.26	6.26	6.26	6.26	6.26	6.26	6
STR 1/ 8	501	**70**	**0**	**8**	7.32	7.30	7.30	7.32	7.32	7.30	7.30	7.32	7.08	7.08	7
STR 1/ 112	501	**63**	**0**	**0**	6.26	6.26	6.26	6.26	6.26	6.26	6.26	6.26	6.26	6.26	6
STR 1/ 57	501	**41**	**0**	**0**	4.14	4.14	4.14	4.14	4.14	4.14	4.14	4.14	4.14	4.14	4
STR 1/ 1	501	**55**	**0**	**0**	5.46	5.46	5.46	5.46	5.46	5.46	5.46	5.46	5.46	5.46	5
STR 1/ 57	501	**41**	**0**	**0**	4.14	4.14	4.14	4.14	4.14	4.14	4.14	4.14	4.14	4.14	4
STR 1/ 8	501	**70**	**0**	**8**	7.32	7.30	7.30	7.32	7.32	7.30	7.30	7.32	7.08	7.08	7
STR 1/ 112	501	**63**	**0**	**0**	6.26	6.26	6.26	6.26	6.26	6.26	6.26	6.26	6.26	6.26	6
STR 1/ 9	501	**53**	**0**	**-1**	5.35	5.35	5.35	5.35	5.35	5.35	5.35	5.35	5.33	5.33	5
STR 1/ 101	501	**396**	**0**	**0**	39.61	39.61	39.61	39.61	39.61	39.61	39.61	39.61	39.61	39.61	40
STR 1/ 1	501	**55**	**0**	**0**	5.46	5.46	5.46	5.46	5.46	5.46	5.46	5.46	5.46	5.46	5
STR 1/ 101	501	**396**	**0**	**0**	39.61	39.61	39.61	39.61	39.61	39.61	39.61	39.61	39.61	39.61	40
STR 3/ 119	501	**403**	**-5**	**-115**	46.07	45.50	45.50	46.07	46.07	45.50	45.50	46.07	42.66	42.66	46
STR 3/ 5	501	**48**	**-5**	**-115**	12.62	10.31	10.31	12.62	12.62	10.31	10.31	12.62	10.14	10.14	13
STR 3/ 119	501	**403**	**-5**	**-115**	46.07	45.50	45.50	46.07	46.07	45.50	45.50	46.07	42.66	42.66	46
STR 3/ 1	501	**64**	**-10**	**-230**	22.90	17.63	17.63	22.90	22.90	17.63	17.63	22.90	18.49	18.49	23
STR 3/ 179	501	**400**	**-5**	**-115**	45.81	45.23	45.23	45.81	45.81	45.23	45.23	45.81	42.39	42.39	46
STR 3/ 5	501	**48**	**-5**	**-115**	12.62	10.31	10.31	12.62	12.62	10.31	10.31	12.62	10.14	10.14	13
STR 3/ 65	501	**49**	**-5**	**-115**	12.72	10.43	10.43	12.72	12.72	10.43	10.43	12.72	10.21	10.21	13
STR 3/ 1	501	**64**	**-10**	**-230**	22.90	17.63	17.63	22.90	22.90	17.63	17.63	22.90	18.49	18.49	23
STR 3/ 65	501	**49**	**-5**	**-115**	12.72	10.43	10.43	12.72	12.72	10.43	10.43	12.72	10.21	10.21	13
STR 3/ 125	501	**46**	**-5**	**-115**	12.51	10.17	10.17	12.51	12.51	10.17	10.17	12.51	10.04	10.04	13
STR 3/ 1	501	**64**	**-10**	**-230**	22.90	17.63	17.63	22.90	22.90	17.63	17.63	22.90	18.49	18.49	23
STR 3/ 125	501	**46**	**-5**	**-115**	12.51	10.17	10.17	12.51	12.51	10.17	10.17	12.51	10.04	10.04	13
STR 3/ 5	501	**48**	**-5**	**-115**	12.62	10.31	10.31	12.62	12.62	10.31	10.31	12.62	10.14	10.14	13
STR 3/ 65	501	**49**	**-5**	**-115**	12.72	10.43	10.43	12.72	12.72	10.43	10.43	12.72	10.21	10.21	13
STR 3/ 1	501	**64**	**-10**	**-230**	22.90	17.63	17.63	22.90	22.90	17.63	17.63	22.90	18.49	18.49	23
STR 3/ 179	501	**400**	**-5**	**-115**	45.81	45.23	45.23	45.81	45.81	45.23	45.23	45.81	42.39	42.39	46
STR 3/ 5	501	**48**	**-5**	**-115**	12.62	10.31	10.31	12.62	12.62	10.31	10.31	12.62	10.14	10.14	13
STR 3/ 179	501	**400**	**-5**	**-115**	45.81	45.23	45.23	45.81	45.81	45.23	45.23	45.81	42.39	42.39	46

Project	FIU Pedestrian Bridge	Date	09/30/16	Page
Project No.	2262.03	Designed	EDL	of
Description	Pipe Connection	Checked	MF	

FIGG

Bolt Forces - Canopy (Member 501)



Shear Force =sqrt(VT^2 + VL^2)/No. bolts + abs(Torque/2.08ft/4bolts)

2.08ft = distance between centroids of corner bolts

No. Bolts =	10									
Bolt No.	1	2	3	4	5	6	7	8	9	10
Sx	0.12	0.12	0.12	0.12	-0.12	-0.12	-0.12	-0.12	0.04	-0.04
Sy	-0.10	-0.03	0.03	0.10	-0.10	-0.03	0.03	0.10	-0.10	-0.10

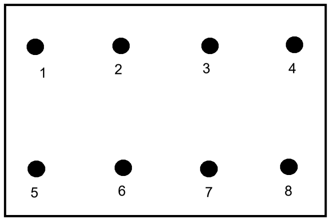
Load Combination Summary - Stength I and III Cases

							Bolt Axial Force (positive = compression, negative = tension)										Bolt Forces						
SUMIT LOAD CASE	MEMBER	VL	VT	FZ	MT	ML	Torque	Bolt 1	Bolt 2	Bolt 3	Bolt 4	Bolt 5	Bolt 6	Bolt 7	Bolt 8	Bolt 9	Bolt 10	T_{u_bolt}, Max Tensile Force	Max Corner Force	$T_{u\_bolttotal}$, Max Total Tension	T_{u_bolt2}, Min Corner Force	Shear Force	Total of All Bolt Tensile Forces	Total of All Bolt Compressive
		kips	kips	kips	kip*ft	kip*ft	kip*ft	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips
STR 1/ 155	501	399	0	202	0	-450	0	67	36	5	-26	67	36	5	-26	67	67	-26	67	-53	-26	40	-53	214
STR 1/ 7	501	59	0	48	-8	-463	7	52	20	-12	-44	54	22	-10	-42	52	53	-44	54	-109	-44	6	-109	147
STR 1/ 155	501	399	0	202	0	-450	0	67	36	5	-26	67	36	5	-26	67	67	-26	67	-53	-26	40	-53	214
STR 1/ 9	501	53	0	45	1	-466	-1	53	21	-11	-44	53	20	-12	-44	53	53	-44	53	-111	-44	5	-111	147
STR 1/ 101	501	396	0	195	0	-316	0	52	30	9	-13	52	30	9	-13	52	52	-13	52	-26	-13	40	-26	182
STR 1/ 8	501	70	0	52	-8	-462	8	52	20	-12	-44	54	22	-10	-42	53	53	-44	54	-107	-44	7	-107	148
STR 1/ 112	501	63	0	50	0	-470	0	54	21	-11	-44	54	21	-11	-44	54	54	-44	54	-110	-44	6	-110	149
STR 1/ 8	501	70	0	52	-8	-462	8	52	20	-12	-44	54	22	-10	-42	53	53	-44	54	-107	-44	7	-107	148
STR 1/ 112	501	63	0	50	0	-470	0	54	21	-11	-44	54	21	-11	-44	54	54	-44	54	-110	-44	6	-110	149
STR 1/ 57	501	41	0	34	0	-334	0	38	15	-8	-31	38	15	-8	-31	38	38	-31	38	-79	-31	4	-79	106
STR 1/ 1	501	55	0	46	0	-461	0	52	20	-11	-43	52	20	-11	-43	52	52	-43	52	-109	-43	5	-109	145
STR 1/ 57	501	41	0	34	0	-334	0	38	15	-8	-31	38	15	-8	-31	38	38	-31	38	-79	-31	4	-79	106
STR 1/ 8	501	70	0	52	-8	-462	8	52	20	-12	-44	54	22	-10	-42	53	53	-44	54	-107	-44	7	-107	148
STR 1/ 112	501	63	0	50	0	-470	0	54	21	-11	-44	54	21	-11	-44	54	54	-44	54	-110	-44	6	-110	149
STR 1/ 9	501	53	0	45	1	-466	-1	53	21	-11	-44	53	20	-12	-44	53	53	-44	53	-111	-44	5	-111	147
STR 1/ 101	501	396	0	195	0	-316	0	52	30	9	-13	52	30	9	-13	52	52	-13	52	-26	-13	40	-26	182
STR 1/ 1	501	55	0	46	0	-461	0	52	20	-11	-43	52	20	-11	-43	52	52	-43	52	-109	-43	5	-109	145
STR 1/ 101	501	396	0	195	0	-316	0	52	30	9	-13	52	30	9	-13	52	52	-13	52	-26	-13	40	-26	182
STR 3/ 119	501	403	-5	200	53	-364	-115	64	39	14	-11	51	26	1	-24	60	56	-24	64	-35	-24	46	-35	195
STR 3/ 5	501	48	-5	47	53	-557	-115	68	30	-8	-47	56	18	-21	-59	64	60	-59	68	-135	-59	13	-135	172
STR 3/ 119	501	403	-5	200	53	-364	-115	64	39	14	-11	51	26	1	-24	60	56	-24	64	-35	-24	46	-35	195
STR 3/ 1	501	64	-10	50	104	-465	-230	65	33	1	-31	41	9	-23	-55	57	49	-55	65	-110	-55	23	-110	149
STR 3/ 179	501	400	-5	193	53	-230	-115	49	33	17	2	37	21	5	-11	45	41	-11	49	-11	-11	46	-11	165
STR 3/ 5	501	48	-5	47	53	-557	-115	68	30	-8	-47	56	18	-21	-59	64	60	-59	68	-135	-59	13	-135	172
STR 3/ 65	501	49	-5	47	53	-558	-115	69	30	-8	-47	56	18	-21	-59	64	60	-59	69	-135	-59	13	-135	173
STR 3/ 1	501	64	-10	50	104	-465	-230	65	33	1	-31	41	9	-23	-55	57	49	-55	65	-110	-55	23	-110	149
STR 3/ 65	501	49	-5	47	53	-558	-115	69	30	-8	-47	56	18	-21	-59	64	60	-59	69	-135	-59	13	-135	173
STR 3/ 125	501	46	-5	40	53	-425	-115	54	25	-4	-34	42	12	-17	-46	50	46	-46	54	-101	-46	13	-101	133
STR 3/ 1	501	64	-10	50	104	-465	-230	65	33	1	-31	41	9	-23	-55	57	49	-55	65	-110	-55	23	-110	149
STR 3/ 125	501	46	-5	40	53	-425	-115	54	25	-4	-34	42	12	-17	-46	50	46	-46	54	-101	-46	13	-101	133
STR 3/ 5	501	48	-5	47	53	-557	-115	68	30	-8	-47	56	18	-21	-59	64	60	-59	68	-135	-59	13	-135	172
STR 3/ 65	501	49	-5	47	53	-558	-115	69	30	-8	-47	56	18	-21	-59	64	60	-59	69	-135	-59	13	-135	173
STR 3/ 1	501	64	-10	50	104	-465	-230	65	33	1	-31	41	9	-23	-55	57	49	-55	65	-110	-55	23	-110	149
STR 3/ 179	501	400	-5	193	53	-230	-115	49	33	17	2	37	21	5	-11	45	41	-11	49	-11	-11	46	-11	165
STR 3/ 5	501	48	-5	47	53	-557	-115	68	30	-8	-47	56	18	-21	-59	64	60	-59	68	-135	-59	13	-135	172
STR 3/ 179	501	400	-5	193	53	-230	-115	49	33	17	2	37	21	5	-11	45	41	-11	49	-11	-11	46	-11	165
Maximum/Minimum Strength 1 & 3 Cases =																		-59	69	-135	-59	46		214

File: Bolt Forces_All Locations_Canopy_Main Span Side_10.3.2016.xls
Tab: Pylon Conn._M501

Project	Date	Page
FIU Pedestrian Bridge	09/30/16	of
Project No. 2262.03	Designed EDL	
Description Pipe Connection	Checked MF	

Bolt Forces - Canopy (Member 502)



Shear Force =sqrt(VT^2 + VL^2)/No. bolts + abs(Torque/2.08ft/4bolts)

2.08ft = distance between centroids of corner bolts

No. Bolts =	8							
Bolt No.	1	2	3	4	5	6	7	8
Sx	0.12	0.12	0.12	0.12	-0.12	-0.12	-0.12	-0.12
Sy	-0.15	-0.05	0.05	0.15	-0.15	-0.05	0.05	0.15

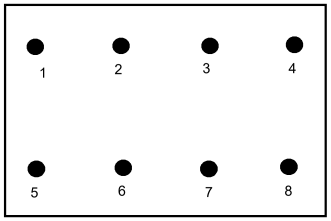
Load Combination Summary - Stength I and III Cases

								Bolt Axial Force (positive = compression, negative = tension)								Bolt Forces						
SUMIT LOAD CASE	MEMBER	VL	VT	FZ	MT	ML	Torque	Bolt 1	Bolt 2	Bolt 3	Bolt 4	Bolt 5	Bolt 6	Bolt 7	Bolt 8	T_{u_bolt}, Max Tensile Force	Max Corner Force	$T_{u\_bolttotal}$, Max Total Tension	T_{u_bolt2}, Min Corner Force	Shear Force	Total of All Bolt Tensile Forces	Total of All Bolt Compressive
		kips	kips	kips	kip*ft	kip*ft	kip*ft	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips
STR 1/ 213	502	143	0	84	0	-206	0	41	21	0	-20	41	21	0	-20	-20	41	-41	-20	18	-41	125
STR 1/ 7	502	-62	0	-14	-7	-298	7	42	12	-18	-47	44	14	-16	-46	-47	44	-126	-47	9	-126	112
STR 1/ 159	502	140	0	88	0	-293	0	55	26	-4	-33	55	26	-4	-33	-33	55	-73	-33	18	-73	161
STR 1/ 9	502	-40	0	-3	1	-303	-1	45	15	-15	-46	45	15	-16	-46	-46	45	-123	-46	5	-123	120
STR 1/ 101	502	93	0	59	0	-195	0	37	17	-2	-22	37	17	-2	-22	-22	37	-49	-22	12	-49	107
STR 1/ 8	502	-51	0	-9	-8	-297	8	42	13	-17	-47	44	15	-15	-45	-47	44	-123	-47	7	-123	114
STR 1/ 111	502	-42	0	-4	0	-305	0	45	15	-16	-46	45	15	-16	-46	-46	45	-124	-46	5	-124	120
STR 1/ 8	502	-51	0	-9	-8	-297	8	42	13	-17	-47	44	15	-15	-45	-47	44	-123	-47	7	-123	114
STR 1/ 111	502	-42	0	-4	0	-305	0	45	15	-16	-46	45	15	-16	-46	-46	45	-124	-46	5	-124	120
STR 1/ 1	502	-93	0	-31	0	-295	0	40	11	-19	-48	40	11	-19	-48	-48	40	-133	-48	12	-133	103
STR 1/ 1	502	-93	0	-31	0	-295	0	40	11	-19	-48	40	11	-19	-48	-48	40	-133	-48	12	-133	103
STR 1/ 55	502	-91	0	-34	0	-208	0	27	6	-15	-35	27	6	-15	-35	-35	27	-100	-35	11	-100	66
STR 1/ 8	502	-51	0	-9	-8	-297	8	42	13	-17	-47	44	15	-15	-45	-47	44	-123	-47	7	-123	114
STR 1/ 111	502	-42	0	-4	0	-305	0	45	15	-16	-46	45	15	-16	-46	-46	45	-124	-46	5	-124	120
STR 1/ 9	502	-40	0	-3	1	-303	-1	45	15	-15	-46	45	15	-16	-46	-46	45	-123	-46	5	-123	120
STR 1/ 101	502	93	0	59	0	-195	0	37	17	-2	-22	37	17	-2	-22	-22	37	-49	-22	12	-49	107
STR 1/ 1	502	-93	0	-31	0	-295	0	40	11	-19	-48	40	11	-19	-48	-48	40	-133	-48	12	-133	103
STR 1/ 101	502	93	0	59	0	-195	0	37	17	-2	-22	37	17	-2	-22	-22	37	-49	-22	12	-49	107
STR 3/ 240	502	163	-8	94	70	-208	-145	51	31	10	-11	35	14	-7	-28	-28	51	-46	-28	38	-46	140
STR 3/ 5	502	-46	-4	-3	39	-370	-75	60	23	-14	-51	50	13	-23	-60	-60	60	-149	-60	15	-149	147
STR 3/ 120	502	161	-8	98	70	-295	-145	65	35	6	-24	48	19	-11	-40	-40	65	-75	-40	37	-75	173
STR 3/ 1	502	-30	-8	2	77	-302	-150	55	25	-6	-36	36	6	-24	-54	-54	55	-120	-54	22	-120	122
STR 3/ 179	502	152	-4	85	39	-137	-75	36	22	9	-5	26	13	-1	-15	-15	36	-21	-15	28	-21	106
STR 3/ 5	502	-46	-4	-3	39	-370	-75	60	23	-14	-51	50	13	-23	-60	-60	60	-149	-60	15	-149	147
STR 3/ 65	502	-37	-4	2	39	-371	-75	61	23	-14	-51	51	14	-23	-60	-60	61	-147	-60	14	-147	149
STR 3/ 1	502	-30	-8	2	77	-302	-150	55	25	-6	-36	36	6	-24	-54	-54	55	-120	-54	22	-120	122
STR 3/ 65	502	-37	-4	2	39	-371	-75	61	23	-14	-51	51	14	-23	-60	-60	61	-147	-60	14	-147	149
STR 3/ 5	502	-46	-4	-3	39	-370	-75	60	23	-14	-51	50	13	-23	-60	-60	60	-149	-60	15	-149	147
STR 3/ 1	502	-30	-8	2	77	-302	-150	55	25	-6	-36	36	6	-24	-54	-54	55	-120	-54	22	-120	122
STR 3/ 125	502	-44	-4	-6	39	-283	-75	46	18	-10	-39	37	9	-20	-48	-48	46	-116	-48	14	-116	110
STR 3/ 5	502	-46	-4	-3	39	-370	-75	60	23	-14	-51	50	13	-23	-60	-60	60	-149	-60	15	-149	147
STR 3/ 65	502	-37	-4	2	39	-371	-75	61	23	-14	-51	51	14	-23	-60	-60	61	-147	-60	14	-147	149
STR 3/ 1	502	-30	-8	2	77	-302	-150	55	25	-6	-36	36	6	-24	-54	-54	55	-120	-54	22	-120	122
STR 3/ 179	502	152	-4	85	39	-137	-75	36	22	9	-5	26	13	-1	-15	-15	36	-21	-15	28	-21	106
STR 3/ 5	502	-46	-4	-3	39	-370	-75	60	23	-14	-51	50	13	-23	-60	-60	60	-149	-60	15	-149	147
STR 3/ 179	502	152	-4	85	39	-137	-75	36	22	9	-5	26	13	-1	-15	-15	36	-21	-15	28	-21	106
															Maximum/Minimum Strength 1 & 3 Cases =	-60	65	-149	-60	38		173

File: Bolt Forces_All Locations_Canopy_Main Span Side_10.3.2016.xls
Tab: Pylon Conn._M502

Project	FIU Pedestrian Bridge	Date	09/30/16	Page
Project No.	2262.03	Designed	EDL	of
Description	Pipe Connection	Checked	MF	

Bolt Forces - Canopy (Member 503)



Shear Force =sqrt(VT^2 + VL^2)/No. bolts + abs(Torque/2.08ft/4bolts)

2.08ft = distance between centroids of corner bolts

longitudinal

No. Bolts =	8							
Bolt No.	1	2	3	4	5	6	7	8
Sx	0.12	0.12	0.12	0.12	-0.12	-0.12	-0.12	-0.12
Sy	-0.15	-0.05	0.05	0.15	-0.15	-0.05	0.05	0.15

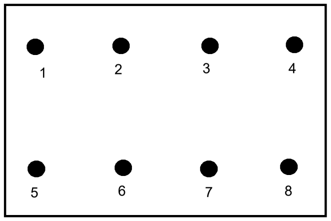
Load Combination Summary - Stength I and III Cases

SUMIT LOAD CASE	MEMBER	VL	VT	FZ	MT	ML	Torque	Bolt Axial Force (positive = compression, negative = tension) Bolt 1	Bolt 2	Bolt 3	Bolt 4	Bolt 5	Bolt 6	Bolt 7	Bolt 8	Bolt Forces T_{u_bolt}, Max Tensile Force	Max Corner Force	$T_{u\_bolttotal}$, Max Total Tension	T_{u_bolt2}, Min Corner Force	Shear Force	Total of All Bolt Tensile Forces	Total of All Bolt Compressive
		kips	kips	kips	kip*ft	kip*ft	kip*ft	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips
STR 1/ 213	503	-1	0	9	0	-117	0	19	7	-5	-17	19	7	-5	-17	-17	19	-43	-17	0	-43	51
STR 1/ 7	503	-131	0	-65	-6	-172	5	17	0	-17	-35	18	1	-16	-33	-35	18	-101	-35	17	-101	37
STR 1/ 159	503	-6	0	9	0	-168	0	26	10	-7	-24	26	10	-7	-24	-24	26	-63	-24	1	-63	72
STR 1/ 9	503	-96	0	-44	1	-175	-1	21	3	-14	-32	21	3	-14	-32	-32	21	-92	-32	12	-92	48
STR 1/ 83	503	-141	0	-74	0	-109	0	7	-4	-15	-26	7	-4	-15	-26	-26	7	-88	-26	18	-88	14
STR 1/ 8	503	-120	0	-58	-8	-171	7	17	0	-17	-34	19	2	-15	-32	-34	19	-97	-34	16	-97	39
STR 1/ 120	503	-56	0	-20	0	-178	0	24	6	-11	-29	24	6	-11	-29	-29	24	-81	-29	7	-81	61
STR 1/ 8	503	-120	0	-58	-8	-171	7	17	0	-17	-34	19	2	-15	-32	-34	19	-97	-34	16	-97	39
STR 1/ 120	503	-56	0	-20	0	-178	0	24	6	-11	-29	24	6	-11	-29	-29	24	-81	-29	7	-81	61
STR 1/ 1	503	-177	0	-92	0	-169	0	14	-3	-20	-37	14	-3	-20	-37	-37	14	-119	-37	22	-119	28
STR 1/ 1	503	-177	0	-92	0	-169	0	14	-3	-20	-37	14	-3	-20	-37	-37	14	-119	-37	22	-119	28
STR 1/ 55	503	-172	0	-92	0	-118	0	6	-6	-17	-29	6	-6	-17	-29	-29	6	-105	-29	21	-105	12
STR 1/ 8	503	-120	0	-58	-8	-171	7	17	0	-17	-34	19	2	-15	-32	-34	19	-97	-34	16	-97	39
STR 1/ 120	503	-56	0	-20	0	-178	0	24	6	-11	-29	24	6	-11	-29	-29	24	-81	-29	7	-81	61
STR 1/ 9	503	-96	0	-44	1	-175	-1	21	3	-14	-32	21	3	-14	-32	-32	21	-92	-32	12	-92	48
STR 1/ 83	503	-141	0	-74	0	-109	0	7	-4	-15	-26	7	-4	-15	-26	-26	7	-88	-26	18	-88	14
STR 1/ 1	503	-177	0	-92	0	-169	0	14	-3	-20	-37	14	-3	-20	-37	-37	14	-119	-37	22	-119	28
STR 1/ 83	503	-141	0	-74	0	-109	0	7	-4	-15	-26	7	-4	-15	-26	-26	7	-88	-26	18	-88	14
STR 3/ 240	503	27	-6	25	49	-119	-83	27	15	3	-9	15	3	-9	-21	-21	27	-38	-21	13	-38	63
STR 3/ 5	503	-100	-3	-43	29	-221	-45	31	9	-13	-35	24	2	-20	-42	-42	31	-110	-42	18	-110	67
STR 3/ 120	503	22	-6	26	49	-169	-83	35	18	1	-16	23	6	-11	-28	-28	35	-55	-28	13	-55	81
STR 3/ 1	503	-86	-7	-37	56	-174	-89	28	11	-7	-24	15	-3	-20	-37	-37	28	-91	-37	21	-91	54
STR 3/ 159	503	-57	-3	-28	29	-70	-45	10	3	-3	-10	4	-3	-10	-17	-17	10	-45	-17	12	-45	17
STR 3/ 5	503	-100	-3	-43	29	-221	-45	31	9	-13	-35	24	2	-20	-42	-42	31	-110	-42	18	-110	67
STR 3/ 75	503	-48	-3	-12	29	-223	-45	35	13	-9	-31	28	6	-16	-38	-38	35	-95	-38	11	-95	83
STR 3/ 1	503	-86	-7	-37	56	-174	-89	28	11	-7	-24	15	-3	-20	-37	-37	28	-91	-37	21	-91	54
STR 3/ 75	503	-48	-3	-12	29	-223	-45	35	13	-9	-31	28	6	-16	-38	-38	35	-95	-38	11	-95	83
STR 3/ 5	503	-100	-3	-43	29	-221	-45	31	9	-13	-35	24	2	-20	-42	-42	31	-110	-42	18	-110	67
STR 3/ 1	503	-86	-7	-37	56	-174	-89	28	11	-7	-24	15	-3	-20	-37	-37	28	-91	-37	21	-91	54
STR 3/ 125	503	-95	-3	-43	29	-170	-45	24	7	-10	-28	17	0	-17	-34	-34	24	-90	-34	17	-90	47
STR 3/ 5	503	-100	-3	-43	29	-221	-45	31	9	-13	-35	24	2	-20	-42	-42	31	-110	-42	18	-110	67
STR 3/ 75	503	-48	-3	-12	29	-223	-45	35	13	-9	-31	28	6	-16	-38	-38	35	-95	-38	11	-95	83
STR 3/ 1	503	-86	-7	-37	56	-174	-89	28	11	-7	-24	15	-3	-20	-37	-37	28	-91	-37	21	-91	54
STR 3/ 159	503	-57	-3	-28	29	-70	-45	10	3	-3	-10	4	-3	-10	-17	-17	10	-45	-17	12	-45	17
STR 3/ 5	503	-100	-3	-43	29	-221	-45	31	9	-13	-35	24	2	-20	-42	-42	31	-110	-42	18	-110	67
STR 3/ 159	503	-57	-3	-28	29	-70	-45	10	3	-3	-10	4	-3	-10	-17	-17	10	-45	-17	12	-45	17
															Maximum/Minimum Strength 1 & 3 Cases =	-42	35	-119	-42	22		83

File: Bolt Forces_All Locations_Canopy_Main Span Side_10.3.2016.xls
Tab: Pylon Conn._M503

Project	Date	Page
FIU Pedestrian Bridge	09/30/16	of
Project No. 2262.03	Designed EDL	
Description Pipe Connection	Checked MF	

Bolt Forces - Canopy (Member 504)



Shear Force =sqrt(VT^2 + VL^2)/No. bolts + abs(Torque/2.08ft/4bolts)

2.08ft = distance between centroids of corner bolts

longitudinal

No. Bolts =	8							
Bolt No.	1	2	3	4	5	6	7	8
Sx	0.12	0.12	0.12	0.12	-0.12	-0.12	-0.12	-0.12
Sy	-0.15	-0.05	0.05	0.15	-0.15	-0.05	0.05	0.15

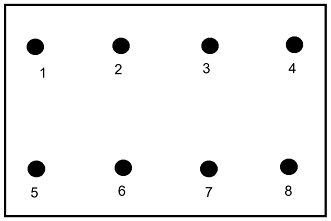
Load Combination Summary - Stength I and III Cases

							Bolt Axial Force (positive = compression, negative = tension)								Bolt Forces						
SUMIT LOAD CASE	MEMBER	VL	VT	FZ	MT	ML	Torque	Bolt 1	Bolt 2	Bolt 3	Bolt 4	Bolt 5	Bolt 6	Bolt 7	Bolt 8	T_{u_bolt}, Max Tensile Force	Max Corner Force	$T_{u\_bolttotal}$, Max Total Tension	T_{u_bolt2}, Min Corner Force	Shear Force	Total of All Bolt Tensile Forces	Total of All Bolt Compressive
		kips	kips	kips	kip*ft	kip*ft	kip*ft	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips
STR 1/ 186	504	-55	0	-35	0	-59	0	4	-1	-7	-13	4	-1	-7	-13	-13	4	-44	-13	7	-44	9
STR 1/ 7	504	-171	0	-121	-6	-79	4	-4	-12	-20	-28	-3	-10	-18	-26	-28	-3	-121	-28	22	-121	0
STR 1/ 186	504	-55	0	-35	0	-59	0	4	-1	-7	-13	4	-1	-7	-13	-13	4	-44	-13	7	-44	9
STR 1/ 9	504	-131	0	-90	2	-82	-2	1	-7	-15	-23	1	-7	-16	-24	-24	1	-92	-24	17	-92	2
STR 1/ 83	504	-224	0	-164	0	-44	0	-14	-18	-23	-27	-14	-18	-23	-27	-27	-14	-164	-27	28	-164	0
STR 1/ 8	504	-161	0	-113	-8	-78	6	-3	-11	-19	-27	-2	-9	-17	-25	-27	-2	-113	-27	21	-113	0
STR 1/ 120	504	-91	0	-60	0	-86	0	5	-3	-12	-20	5	-3	-12	-20	-20	5	-70	-20	11	-70	11
STR 1/ 8	504	-161	0	-113	-8	-78	6	-3	-11	-19	-27	-2	-9	-17	-25	-27	-2	-113	-27	21	-113	0
STR 1/ 120	504	-91	0	-60	0	-86	0	5	-3	-12	-20	5	-3	-12	-20	-20	5	-70	-20	11	-70	11
STR 1/ 28	504	-251	0	-182	0	-71	0	-12	-19	-26	-33	-12	-19	-26	-33	-33	-12	-182	-33	31	-182	0
STR 1/ 1	504	-221	0	-159	0	-77	0	-8	-16	-24	-31	-8	-16	-24	-31	-31	-8	-159	-31	28	-159	0
STR 1/ 28	504	-251	0	-182	0	-71	0	-12	-19	-26	-33	-12	-19	-26	-33	-33	-12	-182	-33	31	-182	0
STR 1/ 8	504	-161	0	-113	-8	-78	6	-3	-11	-19	-27	-2	-9	-17	-25	-27	-2	-113	-27	21	-113	0
STR 1/ 120	504	-91	0	-60	0	-86	0	5	-3	-12	-20	5	-3	-12	-20	-20	5	-70	-20	11	-70	11
STR 1/ 9	504	-131	0	-90	2	-82	-2	1	-7	-15	-23	1	-7	-16	-24	-24	1	-92	-24	17	-92	2
STR 1/ 83	504	-224	0	-164	0	-44	0	-14	-18	-23	-27	-14	-18	-23	-27	-27	-14	-164	-27	28	-164	0
STR 1/ 1	504	-221	0	-159	0	-77	0	-8	-16	-24	-31	-8	-16	-24	-31	-31	-8	-159	-31	28	-159	0
STR 1/ 83	504	-224	0	-164	0	-44	0	-14	-18	-23	-27	-14	-18	-23	-27	-27	-14	-164	-27	28	-164	0
STR 3/ 210	504	-24	-5	-12	34	-59	-40	12	6	0	-6	3	-3	-9	-14	-14	12	-32	-14	8	-32	21
STR 3/ 5	504	-130	-2	-86	21	-111	-23	8	-3	-14	-25	3	-8	-19	-30	-30	8	-98	-30	19	-98	12
STR 3/ 210	504	-24	-5	-12	34	-59	-40	12	6	0	-6	3	-3	-9	-14	-14	12	-32	-14	8	-32	21
STR 3/ 1	504	-120	-5	-82	42	-81	-46	7	-1	-9	-17	-3	-11	-19	-27	-27	7	-89	-27	21	-89	7
STR 3/ 159	504	-134	-2	-99	21	-21	-23	-7	-9	-11	-13	-12	-14	-16	-18	-18	-7	-99	-18	20	-99	0
STR 3/ 5	504	-130	-2	-86	21	-111	-23	8	-3	-14	-25	3	-8	-19	-30	-30	8	-98	-30	19	-98	12
STR 3/ 75	504	-80	-2	-48	21	-113	-23	13	2	-9	-20	8	-3	-14	-25	-25	13	-72	-25	13	-72	24
STR 3/ 1	504	-120	-5	-82	42	-81	-46	7	-1	-9	-17	-3	-11	-19	-27	-27	7	-89	-27	21	-89	7
STR 3/ 75	504	-80	-2	-48	21	-113	-23	13	2	-9	-20	8	-3	-14	-25	-25	13	-72	-25	13	-72	24
STR 3/ 35	504	-160	-2	-109	21	-104	-23	5	-6	-16	-27	-1	-11	-21	-32	-32	5	-114	-32	23	-114	5
STR 3/ 1	504	-120	-5	-82	42	-81	-46	7	-1	-9	-17	-3	-11	-19	-27	-27	7	-89	-27	21	-89	7
STR 3/ 35	504	-160	-2	-109	21	-104	-23	5	-6	-16	-27	-1	-11	-21	-32	-32	5	-114	-32	23	-114	5
STR 3/ 5	504	-130	-2	-86	21	-111	-23	8	-3	-14	-25	3	-8	-19	-30	-30	8	-98	-30	19	-98	12
STR 3/ 75	504	-80	-2	-48	21	-113	-23	13	2	-9	-20	8	-3	-14	-25	-25	13	-72	-25	13	-72	24
STR 3/ 1	504	-120	-5	-82	42	-81	-46	7	-1	-9	-17	-3	-11	-19	-27	-27	7	-89	-27	21	-89	7
STR 3/ 159	504	-134	-2	-99	21	-21	-23	-7	-9	-11	-13	-12	-14	-16	-18	-18	-7	-99	-18	20	-99	0
STR 3/ 5	504	-130	-2	-86	21	-111	-23	8	-3	-14	-25	3	-8	-19	-30	-30	8	-98	-30	19	-98	12
STR 3/ 159	504	-134	-2	-99	21	-21	-23	-7	-9	-11	-13	-12	-14	-16	-18	-18	-7	-99	-18	20	-99	0
Maximum/Minimum Strength 1 & 3 Cases =																-33	13	-182	-33	31		24

File: Bolt Forces_All Locations_Canopy_Main Span Side_10.3.2016.xls
Tab: Pylon Conn._M504

FIGG	Project: FIU Pedestrian Bridge	Date: 09/30/16	Page
	Project No.: 2262.03	Designed: EDL	of
	Description: Pipe Connection	Checked: MF	

Bolt Forces - Canopy (Member 505)



longitudinal

Shear Force =sqrt(VT^2 + VL^2)/No. bolts + abs(Torque/2.08ft/4bolts)

2.08ft = distance between centroids of corner bolts

No. Bolts =	8							
Bolt No.	1	2	3	4	5	6	7	8
Sx	0.12	0.12	0.12	0.12	-0.12	-0.12	-0.12	-0.12
Sy	-0.15	-0.05	0.05	0.15	-0.15	-0.05	0.05	0.15

Load Combination Summary - Stength I and III Cases

								Bolt Axial Force (positive = compression, negative = tension)								Bolt Forces						
SUMIT LOAD CASE	MEMBER	VL	VT	FZ	MT	ML	Torque	Bolt 1	Bolt 2	Bolt 3	Bolt 4	Bolt 5	Bolt 6	Bolt 7	Bolt 8	T_{u_bolt}, Max Tensile Force	Max Corner Force	$T_{u\_bolttotal}$, Max Total Tension	T_{u_bolt2}, Min Corner Force	Shear Force	Total of All Bolt Tensile Forces	Total of All Bolt Compressive
		kips	kips	kips	kip*ft	kip*ft	kip*ft	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips	kips
STR 1/ 186	505	-50	0	-59	0	-21	0	-4	-6	-8	-10	-4	-6	-8	-10	-10	-4	-59	-10	6	-59	0
STR 1/ 8	505	-173	0	-214	-4	-21	2	-24	-26	-28	-30	-23	-25	-27	-29	-30	-23	-214	-30	22	-214	0
STR 1/ 186	505	-50	0	-59	0	-21	0	-4	-6	-8	-10	-4	-6	-8	-10	-10	-4	-59	-10	6	-59	0
STR 1/ 9	505	-139	0	-170	3	-25	-2	-17	-20	-22	-25	-18	-20	-23	-25	-25	-17	-170	-25	18	-170	0
STR 1/ 83	505	-255	0	-320	0	-8	0	-39	-40	-40	-41	-39	-40	-40	-41	-41	-39	-320	-41	32	-320	0
STR 1/ 8	505	-173	0	-214	-4	-21	2	-24	-26	-28	-30	-23	-25	-27	-29	-30	-23	-214	-30	22	-214	0
STR 1/ 129	505	-62	0	-73	0	-31	0	-4	-8	-11	-14	-4	-8	-11	-14	-14	-4	-73	-14	8	-73	0
STR 1/ 8	505	-173	0	-214	-4	-21	2	-24	-26	-28	-30	-23	-25	-27	-29	-30	-23	-214	-30	22	-214	0
STR 1/ 129	505	-62	0	-73	0	-31	0	-4	-8	-11	-14	-4	-8	-11	-14	-14	-4	-73	-14	8	-73	0
STR 1/ 28	505	-268	0	-336	0	-19	0	-39	-41	-43	-45	-39	-41	-43	-45	-45	-39	-336	-45	34	-336	0
STR 1/ 9	505	-139	0	-170	3	-25	-2	-17	-20	-22	-25	-18	-20	-23	-25	-25	-17	-170	-25	18	-170	0
STR 1/ 28	505	-268	0	-336	0	-19	0	-39	-41	-43	-45	-39	-41	-43	-45	-45	-39	-336	-45	34	-336	0
STR 1/ 8	505	-173	0	-214	-4	-21	2	-24	-26	-28	-30	-23	-25	-27	-29	-30	-23	-214	-30	22	-214	0
STR 1/ 129	505	-62	0	-73	0	-31	0	-4	-8	-11	-14	-4	-8	-11	-14	-14	-4	-73	-14	8	-73	0
STR 1/ 9	505	-139	0	-170	3	-25	-2	-17	-20	-22	-25	-18	-20	-23	-25	-25	-17	-170	-25	18	-170	0
STR 1/ 83	505	-255	0	-320	0	-8	0	-39	-40	-40	-41	-39	-40	-40	-41	-41	-39	-320	-41	32	-320	0
STR 1/ 1	505	-219	0	-273	0	-22	0	-31	-33	-35	-37	-31	-33	-35	-37	-37	-31	-273	-37	27	-273	0
STR 1/ 83	505	-255	0	-320	0	-8	0	-39	-40	-40	-41	-39	-40	-40	-41	-41	-39	-320	-41	32	-320	0
STR 3/ 210	505	-24	-3	-27	31	-21	-16	4	1	-1	-3	-4	-6	-8	-10	-10	4	-32	-10	5	-32	5
STR 3/ 5	505	-133	-2	-160	20	-40	-10	-12	-16	-20	-24	-16	-20	-24	-28	-28	-12	-160	-28	18	-160	0
STR 3/ 210	505	-24	-3	-27	31	-21	-16	4	1	-1	-3	-4	-6	-8	-10	-10	4	-32	-10	5	-32	5
STR 3/ 1	505	-135	-4	-165	39	-24	-20	-12	-15	-17	-19	-22	-24	-26	-29	-29	-12	-165	-29	19	-165	0
STR 3/ 159	505	-180	-2	-228	20	4	-10	-27	-26	-26	-26	-31	-31	-31	-30	-31	-26	-228	-31	24	-228	0
STR 3/ 5	505	-133	-2	-160	20	-40	-10	-12	-16	-20	-24	-16	-20	-24	-28	-28	-12	-160	-28	18	-160	0
STR 3/ 83	505	-54	-3	-60	34	-38	-18	2	-2	-5	-9	-6	-10	-14	-17	-17	2	-62	-17	9	-62	2
STR 3/ 1	505	-135	-4	-165	39	-24	-20	-12	-15	-17	-19	-22	-24	-26	-29	-29	-12	-165	-29	19	-165	0
STR 3/ 85	505	-53	-2	-58	20	-45	-10	2	-3	-7	-12	-3	-7	-12	-16	-16	2	-59	-16	8	-59	2
STR 3/ 39	505	-185	-2	-234	20	-4	-10	-26	-27	-27	-27	-31	-31	-32	-32	-32	-26	-234	-32	24	-234	0
STR 3/ 1	505	-135	-4	-165	39	-24	-20	-12	-15	-17	-19	-22	-24	-26	-29	-29	-12	-165	-29	19	-165	0
STR 3/ 39	505	-185	-2	-234	20	-4	-10	-26	-27	-27	-27	-31	-31	-32	-32	-32	-26	-234	-32	24	-234	0
STR 3/ 5	505	-133	-2	-160	20	-40	-10	-12	-16	-20	-24	-16	-20	-24	-28	-28	-12	-160	-28	18	-160	0
STR 3/ 85	505	-53	-2	-58	20	-45	-10	2	-3	-7	-12	-3	-7	-12	-16	-16	2	-59	-16	8	-59	2
STR 3/ 1	505	-135	-4	-165	39	-24	-20	-12	-15	-17	-19	-22	-24	-26	-29	-29	-12	-165	-29	19	-165	0
STR 3/ 169	505	-114	-2	-145	20	-1	-10	-16	-16	-16	-16	-20	-20	-20	-21	-21	-16	-145	-21	15	-145	0
STR 3/ 5	505	-133	-2	-160	20	-40	-10	-12	-16	-20	-24	-16	-20	-24	-28	-28	-12	-160	-28	18	-160	0
STR 3/ 169	505	-114	-2	-145	20	-1	-10	-16	-16	-16	-16	-20	-20	-20	-21	-21	-16	-145	-21	15	-145	0
															Maximum/Minimum Strength 1 & 3 Cases =	-45	4	-336	-45	34		5

File: Bolt Forces_All Locations_Canopy_Main Span Side_10.3.2016.xls
Tab: Pylon Conn._M505

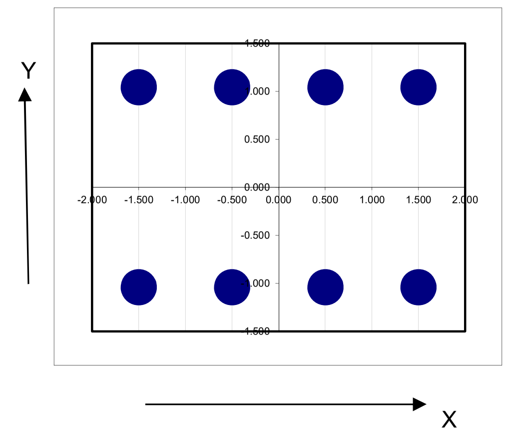
	Project	Date	Page
FIGG	FIU Pedestrian Bridge	08/03/16	of
	Project No. 2262.03	Designed EDL	
	Description Bolt Geometry	Checked MF	

Canopy - Bolted Connections

1) Geometry

1.375 in diameter bolt

Bolt	x (ft)	y (ft)	x^2	y^2	S_x	S_y
1	-1.500	1.042	2.250	1.085	0.12	-0.15
2	-0.500	1.042	0.250	1.085	0.12	-0.05
3	0.500	1.042	0.250	1.085	0.12	0.05
4	1.500	1.042	2.250	1.085	0.12	0.15
5	-1.500	-1.042	2.250	1.085	-0.12	-0.15
6	-0.500	-1.042	0.250	1.085	-0.12	-0.05
7	0.500	-1.042	0.250	1.085	-0.12	0.05
8	1.500	-1.042	2.250	1.085	-0.12	0.15
9			0.000	0.000	0.00	0.00
10			0.000	0.000	0.00	0.00
11			0.000	0.000	0.00	0.00
12			0.000	0.000	0.00	0.00



Σx^2 **10.00**

Σy^2 **8.68**

N = **8** number of bolts

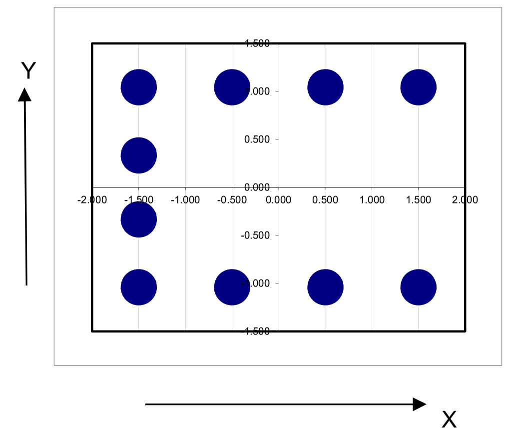
FIGG	Project **FIU Pedestrian Bridge**	Date **08/03/16**	Page of
	Project No. **2262.03**	Designed **EDL**	
	Description **Bolt Geometry**	Checked **MF**	

Canopy - Bolted Connections (Member 501)

1) Geometry

1.375 in **diameter bolt**

Bolt	x (ft)	y (ft)	x^2	y^2	S_x	S_y
1	-1.500	1.042	2.250	1.085	0.12	-0.10
2	-0.500	1.042	0.250	1.085	0.12	-0.03
3	0.500	1.042	0.250	1.085	0.12	0.03
4	1.500	1.042	2.250	1.085	0.12	0.10
5	-1.500	-1.042	2.250	1.085	-0.12	-0.10
6	-0.500	-1.042	0.250	1.085	-0.12	-0.03
7	0.500	-1.042	0.250	1.085	-0.12	0.03
8	1.500	-1.042	2.250	1.085	-0.12	0.10
9	-1.500	0.333	2.250	0.111	0.04	-0.10
10	-1.500	-0.333	2.250	0.111	-0.04	-0.10
11			0.000	0.000	0.00	0.00
12			0.000	0.000	0.00	0.00



Σx^2 **14.50**

Σy^2 **8.90**

N = **10** number of bolts

Pipe Connection Design - ACI Chapter 17

Part I. Check Canopy Connection (Member 501) - Tension:

Ultimate Loads (from AASHTO STR I & STR III Load Combinations):

$T_{u\_bolt} := 24kips$	Concurrent Bolt Tensile Force - Strength Cases
$T_{u\_bolt2} := 24kips$	Concurrent Corner Bolt Tensile Force - Strength Cases
$T_{u\_bolttotal} := 35kips$	Concurrent Sum of All Bolt Tensile Forces - Strength Cases
$V_{u\_bolt} := 46kips$	Max Bolt Shear Force - Strength Cases

Materials Properties and Resistance Factor:

$f'_c := 8500 \cdot psi$	Concrete Strength
$\phi_{anchor} := 0.70$	Resistance Factor for ACI Section 9.2 Combinations (for anchor governed by concrete breakout, side-face blowout, pullout, or pryout strength)

Bolt Properties & Geometry:

$N_{bolt} := 10$	Number of Bolts
$N_{bolt\_corner} := 1$	Number of Grouped Corner Bolts
$d_a := 1.375 \cdot in$	Bolt Diameter
$A_{sen} := 1.16 \cdot in^2$	Effective Area of the Anchor assuming coarse threaded bolt per PCA Notes Table 34-2
$F_{ya} := 105000 \cdot psi$	Yield Strength of Anchor (for 1 - 3/8" diameter F1554 bolts - Grade 105)
$F_{ut} := 125000 \cdot psi$	Min. tensile strength for design
$F_{uta} := \min(1.9 \cdot F_{ya}, 125 \cdot ksi, F_{ut})$	Ultimate tensile strength per ACI 17.4.1.1
$F_{uta} = 125.00 \cdot ksi$	
$h_{ef} := 21 \cdot in$	Effective Embedment Length
$c_{a1} := 7.0 \cdot in$	Transverse Edge Distance to Corner Bolt
$S_1 := 25in$	Spacing Between Bolts - Transverse
$S_2 := 12in$	Spacing Between Bolts - Longitudinal

Pipe Connection Design

a) Steel Strength Check ACI 17.4.1 - Check Tensile Capacity of 1 Bolt

$\phi_{steel} := 0.75$ Resistance factor for anchor governed by strength of ductile steel element - ACI 17.3.3a

$\phi N_{sa} := \phi_{steel} \cdot A_{sen} \cdot F_{uta}$

$\phi N_{sa} = 108.75 \cdot kips$

$$\text{CHECK\_Steel\_Strength} := \begin{cases} \text{"OKAY"} & \text{if } \left(\phi N_{sa} \geq T_{u\_bolt}\right) \\ \text{"NG"} & \text{otherwise} \end{cases}$$

Strength Cases

$\text{CHECK\_Steel\_Strength} = \text{"OKAY"}$

b) Concrete Breakout Strength ACI 17.4.2

Determine A_{nc} and A_{nco} according to ACI 17.4.2.1:

By inspection, worst case occurs when corner bolt is in tension. The failure surface is defined by 1.5 h_{ef} from the corner bolt in both directions.

$$A_{nc} := \left[2 \cdot \left(1.5 \cdot h_{ef}\right)\right] \cdot \left(\left(c_{a1} + 1.5 h_{ef}\right)\right)$$

$A_{nc} = 2425.50 \cdot in^2$

$A_{nco} := 9 \cdot h_{ef}^{\ 2}$

$A_{nco} = 3969.00 \cdot in^2$ Projected area of 35 degree failure plane

$$\text{CHECK\_Areas} := \begin{cases} \text{"OKAY"} & \text{if } \left(A_{nco} \cdot N_{bolt\_corner} \geq A_{nc}\right) \\ \text{"NG"} & \text{otherwise} \end{cases}$$

$\text{CHECK\_Areas} = \text{"OKAY"}$

Pipe Connection Design

Calculate concrete breakout strength

$\varphi_{ecN} := 1.0$ — Factor accounts for No eccentricity in the connection

$\varphi_{edN} := 0.7 + 0.3 \cdot \frac{\min(c_{a1})}{1.5 h_{ef}}$ — Factor accounts for location of the anchor near a free edge

$\varphi_{edN} = 0.77$

$\varphi_{cN} := 1.25$ — Factor for cast-in-place anchors

$\varphi_{cpN} := 1.0$ — Modification factor for cast-in anchors

$k_c := 24$ — For cast-in anchor

$\lambda := 1.0$ — Normal weight concrete

$N_{b1} := k_c \cdot \lambda \cdot \sqrt{\frac{f'_c}{psi}} \cdot \left(\frac{h_{ef}}{in}\right)^{1.5}$ — Basic concrete breakout strength of a single anchor in tension

$N_{b1} = 212936$ lbs

$N_{bmax} := 16 \cdot \lambda \cdot \sqrt{\frac{f'_c}{psi}} \cdot \left(\frac{h_{ef}}{in}\right)^{\left(\frac{5}{3}\right)}$ — Nb max for cast-in headed studs and headed bolts with $h_{ef} > 11in$ and $< 25in$

$N_{bmax} = 235791.57$ lbs

$N_b := \min(N_{b1}, N_{bmax})$

$N_b = 212936.27$ lbs

$N_{cb} := \frac{A_{nc}}{A_{nco}} \cdot \varphi_{edN} \cdot \varphi_{cN} \cdot \varphi_{cpN} \cdot \frac{N_b}{1000}$ — Nominal concrete Breakout strength for a single anchor

$N_{cb} = 124.71$ kips

$\phi_{anchor} \cdot N_{cb} = 87.29$ kips

$$\text{CHECK\_}\phi\text{Ncbg\_capacity} := \begin{cases} \text{"OKAY"} & \text{if } \left(\phi_{anchor} \cdot N_{cb} \geq \frac{T_{u\_bolt2}}{kips}\right) \\ \text{"ADD REINF"} & \text{otherwise} \end{cases}$$

Strength Cases

CHECK_ϕNcbg_capacity = "OKAY"

Pipe Connection Design

$f_y := 60\text{ksi}$

According to Section 17.5.2.9, the design strength of the anchor reinf. shall be permitted to be used instead of the concrete breakout strength in determining tensile capacity.

$\phi_{tension\_reinf} := 0.75$

$T_{u\_bolt2} = 24.00 \cdot \text{kips}$

$A_{s\_req\_tens} := \dfrac{T_{u\_bolt2}}{\phi_{tension\_reinf} \cdot f_y}$ $\qquad A_{s\_req\_tens} = 0.53 \cdot \text{in}^2$

c) Pullout Strength ACI 17.4.3

$\varphi_{cp} := 1.0$ — Factor for pullout strength ACI 17.4.3.6

$A_{brg} := 2.199 \cdot \text{in}^2$ — Conservatively assume regular Hex nut
Abrg per PCA Notes Table 34-2

$N_p := 8 \cdot (A_{brg} \cdot f'_c)$ — Pullout strength in tension of a single headed bolt

$N_p = 149.53 \cdot \text{kips}$

$\phi N_{pn} := \phi_{anchor} \cdot \varphi_{cp} \cdot N_p$ — Nominal Pullout strength of a single bolt

$\phi N_{pn} = 104.67 \cdot \text{kips}$

$$\text{CHECK\_}\phi N_{pn} := \begin{cases} \text{"OKAY"} & \text{if } (\phi N_{pn} \ge T_{u\_bolt}) \\ \text{"NG"} & \text{otherwise} \end{cases}$$

Compare to maximum bolt tensile load in the group (Strength Cases)

$\text{CHECK\_}\phi N_{pn} = \text{"OKAY"}$

Pipe Connection Design

d) Side-Face Blowout ACI 17.4.4

$$\text{Check\_Sidefaceblowout} := \begin{cases} \text{"OKAY"} & \text{if } h_{ef} \le \mathbf{2.5} \cdot c_{a1} \\ \text{"CHECK BLOWOUT"} & \text{otherwise} \end{cases}$$

$\text{Check\_Sidefaceblowout} = \textbf{"CHECK BLOWOUT"}$

$$N_{sb} := \mathbf{160} \cdot \frac{c_{a1}}{in} \cdot \sqrt{\frac{A_{brg}}{in^{\mathbf{2}}}} \cdot \lambda \cdot \sqrt{\frac{f'_c}{psi}}$$

$N_{sb} = \mathbf{153122.88}$ lbs

$\text{Factor} := \mathbf{1.0}$

Factor does not apply since $S_{edge\_long}>3*S_{edge\_trans}$

$$\phi N_{sb} := \phi_{anchor} \cdot \frac{N_{sb}}{\mathbf{1000}} \cdot \text{Factor}$$

$\phi N_{sb} = \mathbf{107.19}$ kips

Nominal Pullout strength of a single bolt

$$\text{CHECK\_}\phi\text{Nsb\_capacity} := \begin{cases} \text{"OKAY"} & \text{if } \left(\phi N_{sb} \ge \frac{T_{u\_bolt}}{kips} \right) \\ \text{"NG"} & \text{otherwise} \end{cases}$$

Strength Cases

$\text{CHECK\_}\phi\text{Nsb\_capacity} = \textbf{"OKAY"}$

Pipe Connection Design

Summary of design strengths based on steel strength, concrete breakout strength, and pullout strength:

Steel Strength (per bolt): $\phi N_{sa} = \mathbf{108.75} \cdot kips$

Embedment Strength - Concrete breakout (one bolt): $\phi_{anchor} \cdot N_{cb} = \mathbf{87.29}$ kips

Provide Reinforcement - 3 #7 bars

Embedment Strength - Pullout (per bolt): $\phi N_{pn} = \mathbf{104.67} \cdot kips$

Embedment Strength - Side Face Blowout (per bolt) $\phi N_{sb} = \mathbf{107.19}$ kips

$\phi N_n := \min(\phi N_{sa}, \phi N_{pn}, \phi N_{sb} \cdot kips)$ $\boxed{\phi N_n = \mathbf{104.67} \cdot kips}$

Canopy Connection Design

Part II. Check Connection - Shear:

a) Steel strength ACI 17.5.1

$\phi_{shear} := \mathbf{0.75}$ — Shear Resistance Factor for anchor governed by concrete pullout - ACI 17.3.3c

$RF := \mathbf{0.80}$ — Reduction factor for built-up grout pads

$V_{sa} := 0.6 A_{sen} \cdot F_{uta} \cdot RF$ — Shear Strength for cast-in headed bolt

$V_{sa} = \mathbf{69.60} \cdot kips$

$\phi_{shear} \cdot V_{sa} = \mathbf{52.20} \cdot kips$

$$CHECK\_\phi Vsa\_capacity := \begin{cases} \textbf{"OKAY"} & \text{if } \left(\phi_{shear} \cdot V_{sa} \geq V_{u\_bolt}\right) \\ \textbf{"NG"} & \text{otherwise} \end{cases}$$ Strength Cases

$CHECK\_\phi Vsa\_capacity = \textbf{"OKAY"}$

b) Concrete breakout strength ACI 17.5.2

By inspection, longitudinal shear will control. Investigate corner connection for shear on one bolt.

$S_{edge\_trans} := \mathbf{7.0} in$ — Transverse edge distance

$h_a := \mathbf{2} \cdot ft + \mathbf{3} in$ — Pylon length where maximum shear occurs

$A_{vc} := \left(2 \cdot \mathbf{1.5} S_{edge\_trans}\right) \cdot h_a$ — $A_{vc} = \mathbf{567.00} \cdot in^2$

$A_{vco} := \mathbf{4.5} \cdot S_{edge\_trans}{}^2$ — $A_{vco} = \mathbf{220.50} \cdot in^2$

$\varphi_{ecv} := \mathbf{1.0}$ — Factor for shear eccentricity

$\varphi_{edv} := \mathbf{1.0}$ — Factor for edge-effect when $S_{edge\_long} > 1.5\ S_{edge\_trans}$

Canopy Connection Design

b) Concrete breakout strength ACI 17.5.2 (continued)

$\varphi_{cv} := 1.4$ — Factor for no cracking at service loads

$$\varphi_{hv} := \max\left(\sqrt{1.5 \cdot \frac{S_{edge\_trans}}{h_a}}, 1\right)$$ — Factor for member thickness

$\varphi_{hv} = 1.00$

$l_e := \min(h_{ef}, 8 \cdot d_a)$ — Limitation of 8da on maximum le allowed

$l_e = 11.00 \cdot in$

$$V_{b1} := 7\left(\frac{l_e}{d_a}\right)^{0.2} \cdot \sqrt{\frac{d_a}{in}} \cdot \lambda \cdot \sqrt{\frac{f'_c}{psi}} \cdot \left(\frac{S_{edge\_trans}}{in}\right)^{1.5}$$

Basic Concrete breakout Strength - ACI 17.5.2.2a

$V_{b1} = 21243.39$ lbs

$$V_{b2} := 9 \cdot \lambda \cdot \sqrt{\frac{f'_c}{psi}} \cdot \left(\frac{S_{edge\_trans}}{in}\right)^{1.5}$$

Basic Concrete breakout Strength - ACI 17.5.2.2b

$V_{b2} = 15367.35$ lbs

$V_b := \min(V_{b1}, V_{b2}) = 15367.35$ lbs

$$V_{cb} := \phi_{anchor} \cdot \frac{A_{vc}}{A_{vco}} \cdot \varphi_{edv} \cdot \varphi_{cv} \cdot \varphi_{hv} \cdot \frac{V_b}{1000}$$

$V_{cb} = 38.73$ kips

$$\text{CHECK\_}\phi\text{Vcbg\_capacity} := \begin{cases} \text{"OKAY"} & \text{if } \left(V_{cb} \geq N_{bolt\_corner} \cdot \frac{V_{u\_bolt}}{kips}\right) \\ \text{"ADD REINF"} & \text{otherwise} \end{cases}$$

Strength Cases

CHECK_ϕVcbg_capacity = "ADD REINF"

Canopy Connection Design

$f_y := 60ksi$

$\phi_{shear\_reinf} := 0.75$

According to Section 17.5.2.9, the design strength of the anchor reinf. shall be permitted to be used instead of the concrete breakout strength in determining shear capacity.

$$A_{s\_req} := \frac{N_{bolt\_corner} \cdot V_{u\_bolt}}{\phi_{shear\_reinf} \cdot f_y} \qquad A_{s\_req} = \mathbf{1.02} \cdot in^2$$

c) Concrete pryout strength of anchor in shear ACI 17.5.3

$k_{cp} := 2.0$ Modification Factor for $h_{ef} > 2.5in$

$V_{cp} := k_{cp} \cdot N_{cb}$

$V_{cp} = \mathbf{249.41}$ kips

$$\text{CHECK\_}\phi\text{Vcp\_capacity} := \begin{cases} \textbf{"OKAY"} & \text{if } \left(\phi_{shear} \cdot V_{cp} \geq \dfrac{N_{bolt\_corner} \cdot V_{u\_bolt}}{kips}\right) \\ \textbf{"NG"} & \text{otherwise} \end{cases}$$

$\text{CHECK\_}\phi\text{Vcp\_capacity} = \textbf{"OKAY"}$

Summary of design strengths based on steel strength, concrete breakout strength, and pryout strength:

Steel Strength (per bolt): $\phi_{shear} \cdot V_{sa} = \mathbf{52.20} \cdot kips$

Embedment Strength - Concrete breakout (per bolt): $V_{cb} = \mathbf{38.73}$ kips

Provide Reinforcement - 3 #6 bars

Embedment Strength - Pryout (per bolt): $\phi_{shear} \cdot V_{cp} = \mathbf{187.06}$ kips

$\phi V_n := \min\left(\phi_{shear} \cdot V_{sa}, \phi_{shear} \cdot V_{cp} \cdot kips\right)$ $\phi V_n = \mathbf{52.20} \cdot kips$

Canopy Connection Design

d) Interaction of tensile and shear force ACI 17.6

Strength Cases:

CHECK_ultimate_shear := | **"Full Strength in Tension shall be permitted"** if $(0.2 \cdot \phi V_n \geq V_{u\_bolt})$
| **"Use Eq. 17.6.3"** otherwise

CHECK_ultimate_shear = **"Use Eq. 17.6.3"**

CHECK_ultimate_tension := | **"Full Strength in Shear shall be permitted"** if $(0.2 \cdot \phi N_n \geq T_{u\_bolt})$
| **"Use Eq. 17.6.3"** otherwise

CHECK_ultimate_tension = **"Use Eq. 17.6.3"**

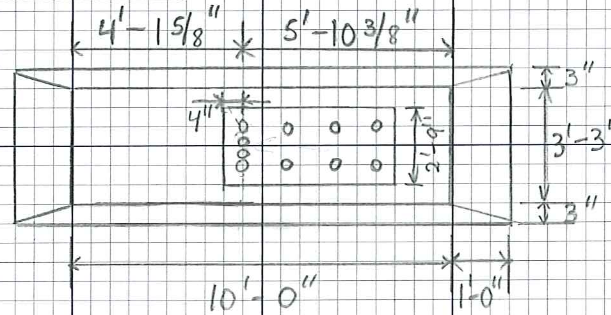
$$\frac{T_{u\_bolt}}{\phi N_n} + \frac{V_{u\_bolt}}{\phi V_n} = \mathbf{1.11}$$

ACI 17.6.3 Eq.

CHECK_ultimate_interaction := | **"OK"** if $\left(\mathbf{1.2} \geq \frac{T_{u\_bolt}}{\phi N_n} + \frac{V_{u\_bolt}}{\phi V_n}\right)$
| **"NG"** otherwise

CHECK_ultimate_interaction = **"OK"**

CANOPY CONNECTION (M501)



$C_{a1,1} = 4.135\ ft = 49.625\ in$

$h_a = 15\ in$

$A_{Vc} = (3\ in + 4\ in + 25\ in + 4\ in + 3\ in) \times (15\ in) = 585\ in^2$

$A_{Vco} = (3.25\ ft) \times (2.25\ ft) = 7.31\ ft^2 = 1053\ in^2$

PER ACI 318-14 17.5.2.2 :

a) $V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2}\sqrt{d_a}\right)\lambda_a \sqrt{f'_c}\,(C_{a1})^{1.5}$

b) $V_b = 9\,\lambda_a \sqrt{f'_c}\,(C_{a1})^{1.5}$

$l_e = \min(h_{ef},\ 8 \cdot d_a) = \min(21\ in,\ 8(1.375\ in))$

$l_e = 11\ in$

a) $V_b = \left(7\left(\frac{11\ in}{1.375\ in}\right)^{0.2}\sqrt{1.375\ in}\right)(1.0)\sqrt{8500\ psi}\,(49.625\ in)^{1.5}$

$V_b = 400{,}984.5\ lbs = 401\ K$

b) $V_b = 9(1.0)\sqrt{8500\ psi}\,(49.625\ in)^{1.5}$

$= 290{,}069.96\ lbs = \underline{290.1\ K} \Leftarrow$ controls

$\Psi_{ec,V} = \underline{1.0}$

$\Psi_{ed,V} = 0.7 + 0.3\,\frac{C_{a2}}{1.5\,C_{a1}}$, if $C_{a2} < 1.5\,C_{a1}$

$C_{a2} = 4\ in + 3\ in = 7\ in < 1.5(49.625\ in) = 74.44\ in$

$\Psi_{ed,V} = 0.7 + 0.3\,\frac{(7\ in)}{74.44\ in} = \underline{0.73}$

$\Psi_{c,V} = \underline{1.4}$

$\Psi_{h,V} = \sqrt{\dfrac{1.5 c_{a1}}{h_a}}$ where $h_a < 1.5 c_{a1}$

$\Psi_{h,V} = \sqrt{\dfrac{1.5(49.625 \text{ in})}{15 \text{in}}} = 2.23$

$V_{cbg} = \phi \dfrac{A_{VC}}{A_{VCO}} \Psi_{ec,V} \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} V_b$

$= 0.7 \left(\dfrac{588 \text{ in}^2}{1053 \text{ in}^2}\right)^{0.56} (1.0)(0.73)(1.4)(2.23)(290.1\text{K})$

$\underline{\underline{V_{cbg} = 256.22\text{K}}}$

$V_u = 403\text{K}$ (FOR ALL BOLTS)

Say $V_{u\text{-critical}} = 0.4(403\text{k}) = 161.2\text{K}$ (FOR FRONT ROW OF BOLTS)

$V_{cbg} = 256.22\text{K} > V_u = 161.2\text{ K} \therefore$ OK//

SEE CALCULATIONS ON NEXT PAGE =>

CANOPY CONNECTION (M501)

PER ACI 318-14, 17.5.2.4, WHERE ANCHORS ARE LOCATED IN NARROW MEMBERS OF LIMITED THICKNESS, C_{a1} SHALL NOT EXCEED THE LARGEST OF:

a) $C_{a2}/1.5$, WHERE C_{a2} IS THE LARGEST EDGE DISTANCE

b) $h_a/1.5$

c) $S/3$, WHERE S IS MAX. SPACING PERPENDICULAR TO DIRECTION OF SHEAR B/T ANCHORS W/IN A GROUP

a) $\frac{C_{a2}}{1.5} = \frac{7in}{1.5} = 4.67 in$

b) $\frac{h_a}{1.5} = \frac{15in}{1.5} = 10 in$ ⇐ controls

c) $\frac{S}{3} = \frac{25in}{3} = 8.33 in$

$V_b = 9\lambda_a\sqrt{f'_c}(C_{a1})^{1.5} = 9(1.0)\sqrt{8500psi}(10in)^{1.5} = 26.2K$

$\Psi_{ec,V} = 1.0$

$\Psi_{ed,V} = 0.7 + 0.3\left(\frac{7in}{10in}\right) = 0.91$

$\Psi_{c,V} = 1.4$

$\Psi_{h,V} = \sqrt{\frac{1.5C_{a1}}{h_a}} = \sqrt{\frac{1.5(10in)}{15in}} = 1.0$

$V_{cbg} = \phi\frac{A_{vc}}{A_{vco}}\Psi_{ec,V}\cdot\Psi_{ed,V}\cdot\Psi_{c,V}\cdot\Psi_{h,V}\cdot V_b$

$A_{vc} = (7in + 25in + 7in)(\underbrace{15in}_{h_a}) = 585 in$

$A_{vco} = 4.5C_{a1}^2 = 4.5(10in)^2 = 450 in$

$\frac{A_{vc}}{A_{vco}} = \frac{585}{450} = 1.3$

$V_{cbg} = 0.7(1.3)(1.0)(0.91)(1.4)(1.0)(26.2K) = \underline{30.4K} < V_u = 161.2K$

∴ N.G.

· PROVIDE REINFORCEMENT FOR CONCRETE BREAKOUT DUE TO SHEAR:

$A_{s\text{-}req} = \frac{V_u}{\phi f_y} = \frac{161.2K}{0.75(60ksi)} = 3.58 in^2$ ⇒ $\boxed{\text{PROVIDE 9 LEGS OF \#6 BARS}}$

CODE

(b) Anchor spacing s is not less than 2.5 in.
(c) Reinforcement is provided at the corners if $c_{a2} \leq 1.5h_{ef}$

17.5.2.4 Where anchors are located in narrow sections of limited thickness such that both edge distances c_{a2} and thickness h_a are less than $1.5c_{a1}$, the value of c_{a1} used for the calculation of A_{Vc} in accordance with 17.5.2.1 as well as for the equations in 17.5.2.1 through 17.5.2.8 shall not exceed the largest of:

(a) $c_{a2}/1.5$, where c_{a2} is the largest edge distance
(b) $h_a/1.5$
(c) $s/3$, where s is the maximum spacing perpendicular to direction of shear, between anchors within a group

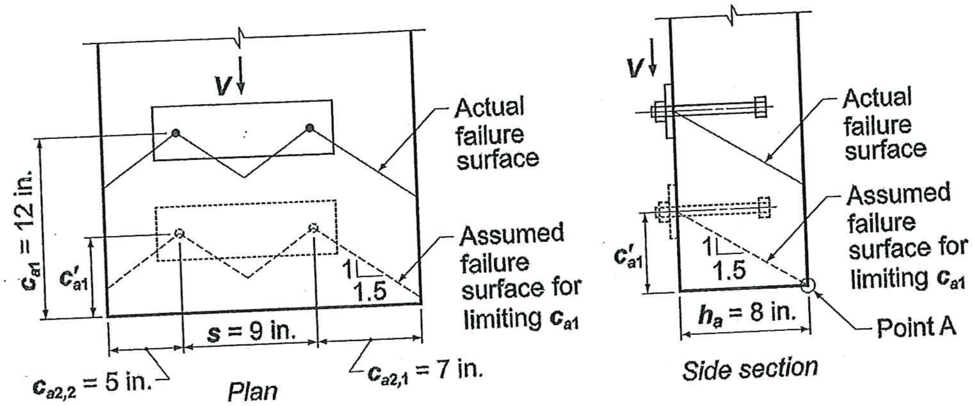
COMMENTARY

R17.5.2.4 For the case of anchors located in narrow sections of limited thickness where the edge distances perpendicular to the direction of load and the member thickness are less than $1.5c_{a1}$, the shear breakout strength calculated by the basic CCD Method (refer to R17.3.2) is overly conservative. These cases were studied for the Kappa Method (Eligehausen and Fuchs 1988) and the problem was pointed out by Lutz (1995). Similar to the approach used for concrete breakout strength in tension in 17.4.2.3, the concrete breakout strength in shear for this case is more accurately evaluated if the value of c_{a1} used in the equations in 17.5.2.1 through 17.5.2.8 and in the calculation of A_{Vc} is limited to the maximum of two-thirds of the larger of the two edge distances perpendicular to the direction of shear, two-thirds of the member thickness, and one-third of the maximum spacing between anchors within the group, measured perpendicular to the direction of shear. The limit on c_{a1} of at least one-third of the maximum spacing between anchors within the group prevents the use of a calculated strength based on individual breakout prisms for a group anchor configuration.

This approach is illustrated in Fig. R17.5.2.4. In this example, the limiting value of c_{a1} is denoted as c'_{a1} and is used for the calculation of A_{Vc}, A_{Vco}, $\psi_{ed,V}$, and $\psi_{h,V}$ as well as for V_b (not shown). The requirement of 17.5.2.4 may be visualized by moving the actual concrete breakout surface originating at the actual c_{a1} toward the surface of the concrete in the direction of the applied shear load. The value of c_{a1} used for the calculation of A_{Vc} and in the equations in 17.5.2.1 through 17.5.2.8 is determined when either: (a) an outer boundary of the failure surface first intersects the concrete surface; or (b) the intersection of the breakout surface between anchors within the group first intersects the concrete surface. For the example shown in Fig. R17.5.2.4, Point A shows the intersection of the assumed failure surface for limiting c_{a1} with the concrete surface.

CODE

COMMENTARY



1. The actual c_{a1} = 12 in.
2. The two edge distances c_{a2} as well as h_a are all less than $1.5c_{a1}$.
3. The limiting value of c_{a1} (shown as c'_{a1} in the figure) to be used for the calculation of A_{Vc} and in the equations 17.5.2.1 through 17.5.2.8 is determined as the largest of the following:

   $(c_{a2,max})/1.5 = (7)/1.5 = 4.67$ in.

   $(h_a)/1.5 = (8)/1.5 = 5.33$ in. (controls)

   $s/3 = 1/3(9) = 3$ in.

4. For this case, A_{Vc}, A_{Vco}, $\psi_{ed,V}$, and $\psi_{h,V}$ are determined as follows:

   $A_{Vc} = (5 + 9 + 7)(1.5 \times 5.33) = 168$ in.^{2}

   $A_{Vco} = 4.5(5.33)^2 = 128$ in.^{2}

   $\psi_{ed,V} = 0.7 + 0.3(5)/5.33 = 0.98$

$\psi_{h,V} = 1.0$ because $c_{a1} = (h_a)/1.5$. Point A shows the intersection of the assumed failure surface with the concrete surface that establishes the limiting value of c_{a1}.

Fig. R17.5.2.4—Example of shear where anchors are located in narrow members of limited thickness.

17.5.2.5 The modification factor for anchor groups loaded eccentrically in shear, $\psi_{ec,V}$, shall be calculated as

$$\psi_{ec,V} = \frac{1}{\left(1+\frac{2e'_V}{3c_{a1}}\right)} \tag{17.5.2.5}$$

but $\psi_{ec,V}$ shall not be taken greater than 1.0.

If the loading on an anchor group is such that only some anchors are loaded in shear in the same direction, only those anchors that are loaded in shear in the same direction shall be considered when determining the eccentricity of e'_V for use in Eq. (17.5.2.5) and for the calculation of V_{cbg} according to Eq. (17.5.2.1b).

R17.5.2.5 This section provides a modification factor for an eccentric shear force toward an edge on a group of anchors. If the shear force originates above the plane of the concrete surface, the shear should first be resolved as a shear in the plane of the concrete surface, with a moment that may or may not also cause tension in the anchors, depending on the normal force. Figure R17.5.2.5 defines the term e'_V for calculating the $\psi_{ec,V}$ modification factor that accounts for the fact that more shear is applied to one anchor than others, tending to split the concrete near an edge.

17

CODE

COMMENTARY

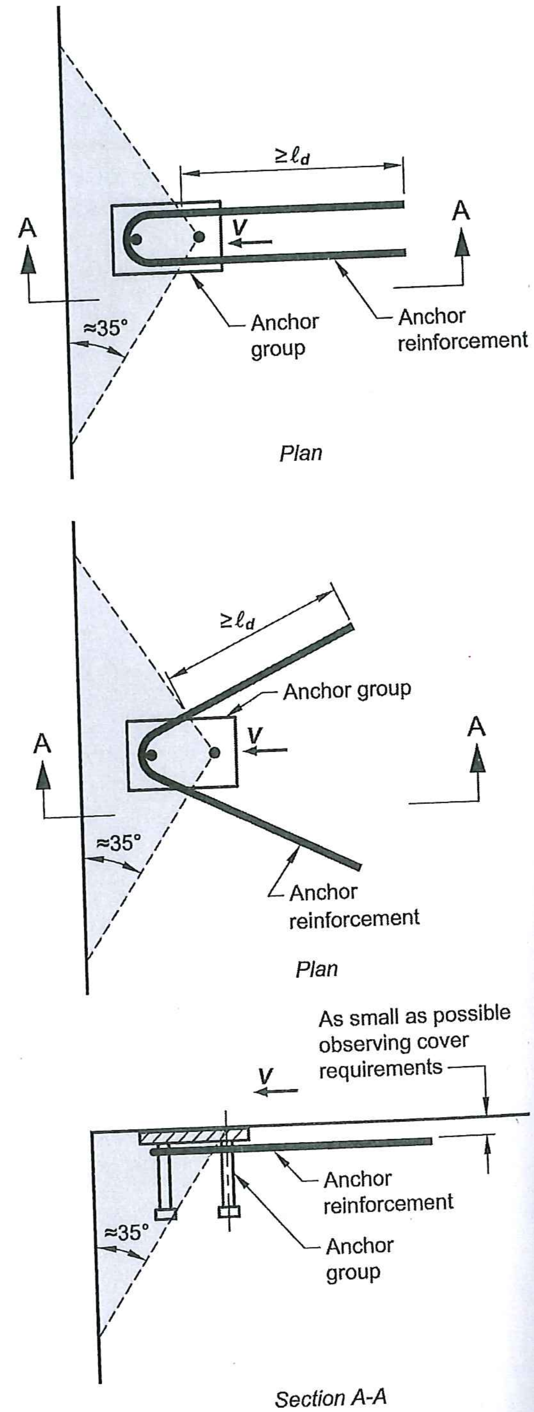


Fig. R17.5.2.9a—Hairpin anchor reinforcement for shear.

CODE

COMMENTARY

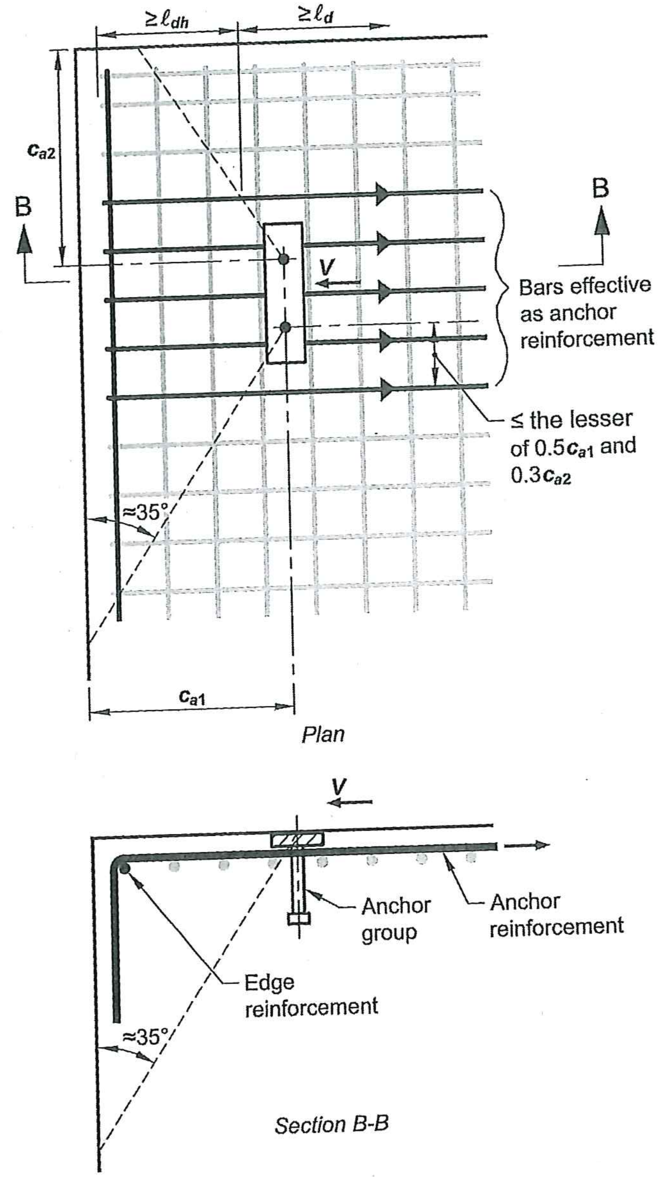


Fig. R17.5.2.9b—Edge reinforcement and anchor reinforcement for shear.

17.5.3 *Concrete pryout strength of anchor in shear*

17.5.3.1 The nominal pryout strength, V_{cp} for a single anchor or V_{cpg} for a group of anchors, shall not exceed:

(a) For a single anchor

$$V_{cp} = k_{cp} N_{cp} \quad (17.5.3.1a)$$

For cast-in, expansion, and undercut anchors, N_{cp} shall be taken as N_{cb} determined from Eq. (17.4.2.1a), and for adhesive anchors, N_{cp} shall be the lesser of N_a determined from Eq. (17.4.5.1a) and N_{cb} determined from Eq. (17.4.2.1a).

(b) For a group of anchors

R17.5.3 *Concrete pryout strength of anchor in shear*

R17.5.3.1 Fuchs et al. (1995) indicates that the pryout shear resistance can be approximated as one to two times the anchor tensile resistance with the lower value appropriate for h_{ef} less than 2.5 in. Because it is possible that the bond strength of adhesive anchors could be less than the concrete breakout strength, it is necessary to consider both 17.4.2.1 and 17.4.5.1 for determination of the pryout strength.

Pipe Connection Design - ACI Chapter 17

Part I. Check Canopy Connection (Member 502) - Tension:

Ultimate Loads (from AASHTO STR I & STR III Load Combinations):

$T_{u\_bolt} := 28kips$	Maximum Bolt Tensile Force - Strength Cases
$T_{u\_bolt2} := 28kips$	Max Corner Bolt Tensile Force - Strength Cases
$T_{u\_bolttotal} := 46kips$	Max Sum of All Bolt Tensile Forces - Strength Cases
$V_{u\_bolt} := 38kips$	Concurrent Bolt Shear Force - Strength Cases

Materials Properties and Resistance Factor:

$f'_c := 8500 \cdot psi$	Concrete Strength
$\phi_{anchor} := 0.70$	Resistance Factor for ACI Section 9.2 Combinations (for anchor governed by concrete breakout, side-face blowout, pullout, or pryout strength)

Bolt Properties & Geometry:

$N_{bolt} := 8$	Number of Bolts
$N_{bolt\_corner} := 1$	Number of Grouped Corner Bolts
$d_a := 1.375 \cdot in$	Bolt Diameter
$A_{sen} := 1.16 \cdot in^2$	Effective Area of the Anchor assuming coarse threaded bolt per PCA Notes Table 34-2
$F_{ya} := 105000 \cdot psi$	Yield Strength of Anchor (for 1 - 3/8" diameter F1554 bolts - Grade 105)
$F_{ut} := 125000 \cdot psi$	Min. tensile strength for design
$F_{uta} := \min(1.9 \cdot F_{ya}, 125 \cdot ksi, F_{ut})$	Ultimate tensile strength per ACI 17.4.1.1
$F_{uta} = 125.00 \cdot ksi$	
$h_{ef} := 21 \cdot in$	Effective Embedment Length
$c_{a1} := 7.0 \cdot in$	Transverse Edge Distance to Corner Bolt
$S_1 := 25in$	Spacing Between Bolts - Transverse
$S_2 := 12in$	Spacing Between Bolts - Longitudinal

Pipe Connection Design

a) Steel Strength Check ACI 17.4.1 - Check Tensile Capacity of 1 Bolt

$\phi_{steel} := \mathbf{0.75}$

Resistance factor for anchor governed by strength of ductile steel element - ACI 17.3.3a

$\phi N_{sa} := \phi_{steel} \cdot A_{sen} \cdot F_{uta}$

$\phi N_{sa} = \mathbf{108.75} \cdot kips$

$$CHECK\_Steel\_Strength := \begin{vmatrix} \textbf{"OKAY"} & \text{if } (\phi N_{sa} \geq T_{u\_bolt}) \\ \textbf{"NG"} & \text{otherwise} \end{vmatrix}$$

Strength Cases

$CHECK\_Steel\_Strength = \textbf{"OKAY"}$

b) Concrete Breakout Strength ACI 17.4.2

Determine A_{nc} and A_{nco} according to ACI 17.4.2.1:

By inspection, worst case occurs when corner bolt is in tension. The failure surface is defined by 1.5 h_{ef} from the corner bolt in both directions.

$A_{nc} := [\mathbf{2} \cdot (\mathbf{1.5} \cdot h_{ef})] \cdot ((c_{a1} + \mathbf{1.5} h_{ef}))$

$A_{nc} = \mathbf{2425.50} \cdot in^{\mathbf{2}}$

$A_{nco} := \mathbf{9} \cdot h_{ef}^{\mathbf{2}}$

$A_{nco} = \mathbf{3969.00} \cdot in^{\mathbf{2}}$

Projected area of 35 degree failure plane

$$CHECK\_Areas := \begin{vmatrix} \textbf{"OKAY"} & \text{if } (A_{nco} \cdot N_{bolt\_corner} \geq A_{nc}) \\ \textbf{"NG"} & \text{otherwise} \end{vmatrix}$$

$CHECK\_Areas = \textbf{"OKAY"}$

Pipe Connection Design

Calculate concrete breakout strength

$\varphi_{ecN} := \mathbf{1.0}$ — Factor accounts for No eccentricity in the connection

$\varphi_{edN} := \mathbf{0.7} + \mathbf{0.3} \cdot \dfrac{\min(c_{a1})}{\mathbf{1.5} h_{ef}}$ — Factor accounts for location of the anchor near a free edge

$\varphi_{edN} = \mathbf{0.77}$

$\varphi_{cN} := \mathbf{1.25}$ — Factor for cast-in-place anchors

$\varphi_{cpN} := \mathbf{1.0}$ — Modification factor for cast-in anchors

$k_c := \mathbf{24}$ — For cast-in anchor

$\lambda := \mathbf{1.0}$ — Normal weight concrete

$N_{b1} := k_c \cdot \lambda \cdot \sqrt{\dfrac{f'_c}{psi}} \cdot \left(\dfrac{h_{ef}}{in}\right)^{\mathbf{1.5}}$ — Basic concrete breakout strength of a single anchor in tension

$N_{b1} = \mathbf{212936}\ \text{lbs}$

$N_{bmax} := \mathbf{16} \cdot \lambda \cdot \sqrt{\dfrac{f'_c}{psi}} \cdot \left(\dfrac{h_{ef}}{in}\right)^{\left(\frac{5}{3}\right)}$ — Nb max for cast-in headed studs and headed bolts with h_{ef} >11in and <25in

$N_{bmax} = \mathbf{235791.57}\ \text{lbs}$

$N_b := \min(N_{b1}, N_{bmax})$

$N_b = \mathbf{212936.27}\ \text{lbs}$

$N_{cb} := \dfrac{A_{nc}}{A_{nco}} \cdot \varphi_{edN} \cdot \varphi_{cN} \cdot \varphi_{cpN} \cdot \dfrac{N_b}{\mathbf{1000}}$ — Nominal concrete Breakout strength for a single anchor

$N_{cb} = \mathbf{124.71}\ \text{kips}$

$\phi_{anchor} \cdot N_{cb} = \mathbf{87.29}\ \text{kips}$

$$\text{CHECK\_}\phi\text{Ncbg\_capacity} := \begin{cases} \textbf{"OKAY"} & \text{if } \left(\phi_{anchor} \cdot N_{cb} \ge \dfrac{T_{u\_bolt2}}{kips}\right) \\ \textbf{"ADD REINF"} & \text{otherwise} \end{cases}$$

Strength Cases

$\text{CHECK\_}\phi\text{Ncbg\_capacity} = \textbf{"OKAY"}$

Pipe Connection Design

c) Pullout Strength ACI 17.4.3

$\varphi_{cp} := \mathbf{1.0}$ — Factor for pullout strength ACI 17.4.3.6

$A_{brg} := \mathbf{2.199} \cdot in^2$ — Conservatively assume regular Hex nut
Abrg per PCA Notes Table 34-2

$N_p := \mathbf{8} \cdot (A_{brg} \cdot f'_c)$ — Pullout strength in tension of a single headed bolt

$N_p = \mathbf{149.53} \cdot kips$

$\phi N_{pn} := \phi_{anchor} \cdot \varphi_{cp} \cdot N_p$ — Nominal Pullout strength of a single bolt

$\phi N_{pn} = \mathbf{104.67} \cdot kips$

$CHECK\_\phi N_{pn} := \begin{cases} \textbf{"OKAY"} & \text{if } (\phi N_{pn} \geq T_{u\_bolt}) \\ \textbf{"NG"} & \text{otherwise} \end{cases}$ — Compare to maximum bolt tensile load in the group (Strength Cases)

$CHECK\_\phi N_{pn} = \textbf{"OKAY"}$

Pipe Connection Design

d) Side-Face Blowout ACI 17.4.4

$$\text{Check\_Sidefaceblowout} := \begin{cases} \textbf{"OKAY"} & \text{if } h_{ef} \le \mathbf{2.5} \cdot c_{a1} \\ \textbf{"CHECK BLOWOUT"} & \text{otherwise} \end{cases}$$

$$\text{Check\_Sidefaceblowout} = \textbf{"CHECK BLOWOUT"}$$

$$N_{sb} := \mathbf{160} \cdot \frac{c_{a1}}{in} \cdot \sqrt{\frac{A_{brg}}{in^{\mathbf{2}}}} \cdot \lambda \cdot \sqrt{\frac{f'_c}{psi}}$$

$$N_{sb} = \mathbf{153122.88} \ \text{lbs}$$

$$\text{Factor} := \mathbf{1.0}$$

Factor does not apply since S_{edge_long}>3*S_{edge_trans}

$$\phi N_{sb} := \phi_{anchor} \cdot \frac{N_{sb}}{\mathbf{1000}} \cdot \text{Factor}$$

$$\phi N_{sb} = \mathbf{107.19} \quad \text{kips}$$

Nominal Pullout strength of a single bolt

$$\text{CHECK\_}\phi\text{Nsb\_capacity} := \begin{cases} \textbf{"OKAY"} & \text{if } \left(\phi N_{sb} \ge \frac{T_{u\_bolt}}{kips}\right) \\ \textbf{"NG"} & \text{otherwise} \end{cases}$$

Strength Cases

$$\text{CHECK\_}\phi\text{Nsb\_capacity} = \textbf{"OKAY"}$$

Pipe Connection Design

Summary of design strengths based on steel strength, concrete breakout strength, and pullout strength:

Steel Strength (per bolt):	$\phi N_{sa} = \mathbf{108.75} \cdot kips$
Embedment Strength - Concrete breakout (one bolt):	$\phi_{anchor} \cdot N_{cb} = \mathbf{87.29}$ kips
Embedment Strength - Pullout (per bolt):	$\phi N_{pn} = \mathbf{104.67} \cdot kips$
Embedment Strength - Side Face Blowout (per bolt)	$\phi N_{sb} = \mathbf{107.19}$ kips

$\phi N_n := \min(\phi N_{sa}, \phi_{anchor} \cdot N_{cb} \cdot kips, \phi N_{pn}, \phi N_{sb} \cdot kips)$ $\boxed{\phi N_n = \mathbf{87.29} \cdot kips}$

Canopy Connection Design

Part II. Check Connection - Shear:

a) Steel strength ACI 17.5.1

$\phi_{shear} := \mathbf{0.70}$ — Shear Resistance Factor for anchor governed by concrete breakout - ACI 17.3.3c

$RF := \mathbf{0.80}$ — Reduction factor for built-up grout pads

$V_{sa} := 0.6 A_{sen} \cdot F_{uta} \cdot RF$ — Shear Strength for cast-in headed bolt

$V_{sa} = \mathbf{69.60} \cdot kips$

$\phi_{shear} \cdot V_{sa} = \mathbf{48.72} \cdot kips$

$$CHECK\_\phi Vsa\_capacity := \begin{cases} \textbf{"OKAY"} & \text{if } \left(\phi_{shear} \cdot V_{sa} \geq V_{u\_bolt}\right) \\ \textbf{"NG"} & \text{otherwise} \end{cases}$$

Strength Cases

$CHECK\_\phi Vsa\_capacity = \textbf{"OKAY"}$

b) Concrete breakout strength ACI 17.5.2

By inspection, longitudinal shear will control. Investigate corner connection for shear on one bolt.

$S_{edge\_trans} := \mathbf{7.0} in$ — Transverse edge distance

$h_a := \mathbf{2} \cdot ft + \mathbf{3} in$ — Pylon length where maximum shear occurs

$A_{vc} := \left(2 \cdot \mathbf{1.5} S_{edge\_trans}\right) \cdot h_a$ $\qquad A_{vc} = \mathbf{567.00} \cdot in^2$

$A_{vco} := \mathbf{4.5} \cdot S_{edge\_trans}{}^2$ $\qquad A_{vco} = \mathbf{220.50} \cdot in^2$

$\varphi_{ecv} := \mathbf{1.0}$ — Factor for shear eccentricity

$\varphi_{edv} := \mathbf{1.0}$ — Factor for edge-effect when $S_{edge\_long} > 1.5\ S_{edge\_trans}$

Canopy Connection Design

b) Concrete breakout strength ACI 17.5.2 (continued)

$\varphi_{cv} := 1.4$ — Factor for no cracking at service loads

$\varphi_{hv} := \max\left(\sqrt{1.5 \cdot \frac{S_{edge\_trans}}{h_a}}, 1\right)$ — Factor for member thickness

$\varphi_{hv} = 1.00$

$l_e := \min(h_{ef}, 8 \cdot d_a)$ — Limitation of 8da on maximum le allowed

$l_e = 11.00 \cdot in$

$$V_{b1} := 7\left(\frac{l_e}{d_a}\right)^{0.2} \cdot \sqrt{\frac{d_a}{in}} \cdot \lambda \cdot \sqrt{\frac{f'_c}{psi}} \cdot \left(\frac{S_{edge\_trans}}{in}\right)^{1.5}$$

Basic Concrete breakout Strength - ACI 17.5.2.2a

$V_{b1} = 21243.39$ lbs

$$V_{b2} := 9 \cdot \lambda \cdot \sqrt{\frac{f'_c}{psi}} \cdot \left(\frac{S_{edge\_trans}}{in}\right)^{1.5}$$

Basic Concrete breakout Strength - ACI 17.5.2.2b

$V_{b2} = 15367.35$ lbs

$V_b := \min(V_{b1}, V_{b2}) = 15367.35$ lbs

$$V_{cb} := \phi_{anchor} \cdot \frac{A_{vc}}{A_{vco}} \cdot \varphi_{edv} \cdot \varphi_{cv} \cdot \varphi_{hv} \cdot \frac{V_b}{1000}$$

$V_{cb} = 38.73$ kips

$$\text{CHECK\_}\phi\text{Vcbg\_capacity} := \begin{cases} \text{"OKAY"} & \text{if } \left(V_{cb} \geq N_{bolt\_corner} \cdot \frac{V_{u\_bolt}}{kips}\right) \\ \text{"NG"} & \text{otherwise} \end{cases}$$

Strength Cases

CHECK_ϕVcbg_capacity = **"OKAY"**

Canopy Connection Design

$f_y := 60\text{ksi}$

$\phi_{shear\_reinf} := 0.75$

According to Section 17.5.2.9, the design strength of the anchor reinf. shall be permitted to be used instead of the concrete breakout strength in determining shear capacity.

$$A_{s\_req} := \frac{N_{bolt\_corner} \cdot V_{u\_bolt}}{\phi_{shear\_reinf} \cdot f_y}$$

$A_{s\_req} = 0.84 \cdot in^2$

c) Concrete pryout strength of anchor in shear ACI 17.5.3

$k_{cp} := 2.0$

Modification Factor for $h_{ef} > 2.5in$

$V_{cp} := k_{cp} \cdot N_{cb}$

$V_{cp} = 249.41$ kips

$$\text{CHECK\_}\phi\text{Vcp\_capacity} := \begin{cases} \text{"OKAY"} & \text{if } \left(\phi_{shear} \cdot V_{cp} \geq \dfrac{N_{bolt\_corner} \cdot V_{u\_bolt}}{kips}\right) \\ \text{"NG"} & \text{otherwise} \end{cases}$$

$\text{CHECK\_}\phi\text{Vcp\_capacity} = \text{"OKAY"}$

Summary of design strengths based on steel strength, concrete breakout strength, and pryout strength:

Steel Strength (per bolt): $\phi_{shear} \cdot V_{sa} = 48.72 \cdot kips$

Embedment Strength - Concrete breakout (per bolt): $V_{cb} = 38.73$ kips

Provide reinforcement - 2 #6 bars

Embedment Strength - Pryout (per bolt): $\phi_{shear} \cdot V_{cp} = 174.59$ kips

$\phi V_n := \min(\phi_{shear} \cdot V_{sa}, \phi_{shear} \cdot V_{cp} \cdot kips)$

$\phi V_n = 48.72 \cdot kips$

Canopy Connection Design

d) Interaction of tensile and shear force ACI 17.6

Strength Cases:

$$\text{CHECK\_ultimate\_shear} := \begin{cases} \textbf{"Full Strength in Tension shall be permitted"} & \text{if } (\mathbf{0.2} \cdot \phi V_n \geq V_{u\_bolt}) \\ \textbf{"Use Eq. 17.6.3"} & \text{otherwise} \end{cases}$$

CHECK_ultimate_shear = **"Use Eq. 17.6.3"**

$$\text{CHECK\_ultimate\_tension} := \begin{cases} \textbf{"Full Strength in Shear shall be permitted"} & \text{if } (\mathbf{0.2} \cdot \phi N_n \geq T_{u\_bolt}) \\ \textbf{"Use Eq. 17.6.3"} & \text{otherwise} \end{cases}$$

CHECK_ultimate_tension = **"Use Eq. 17.6.3"**

$$\frac{T_{u\_bolt}}{\phi N_n} + \frac{V_{u\_bolt}}{\phi V_n} = \mathbf{1.10}$$

ACI 17.6.3 Eq.

$$\text{CHECK\_ultimate\_interaction} := \begin{cases} \textbf{"OK"} & \text{if } \left(\mathbf{1.2} \geq \frac{T_{u\_bolt}}{\phi N_n} + \frac{V_{u\_bolt}}{\phi V_n}\right) \\ \textbf{"NG"} & \text{otherwise} \end{cases}$$

CHECK_ultimate_interaction = **"OK"**

CODE

Ductile steel element — An element with a tensile test elongation of at least 14 percent and reduction in area of at least 30 percent. A steel element meeting the requirements of ASTM A307 shall be considered ductile.

Edge distance — The distance from the edge of the concrete surface to the center of the nearest anchor.

Effective embedment depth — The overall depth through which the anchor transfers force to or from the surrounding concrete. The effective embedment depth will normally be the depth of the concrete failure surface in tension applications. For cast-in headed anchor bolts and headed studs, the effective embedment depth is measured from the bearing contact surface of the head.

Expansion anchor — A post-installed anchor, inserted into hardened concrete that transfers loads to or from the concrete by direct bearing or friction or both. Expansion anchors may be torque-controlled, where the expansion is achieved by a torque acting on the screw or bolt; or displacement-controlled, where the expansion is achieved by impact forces acting on a sleeve or plug and the expansion is controlled by the length of travel of the sleeve or plug.

Expansion sleeve — The outer part of an expansion anchor that is forced outward by the center part, either by applied torque or impact, to bear against the sides of the predrilled hole.

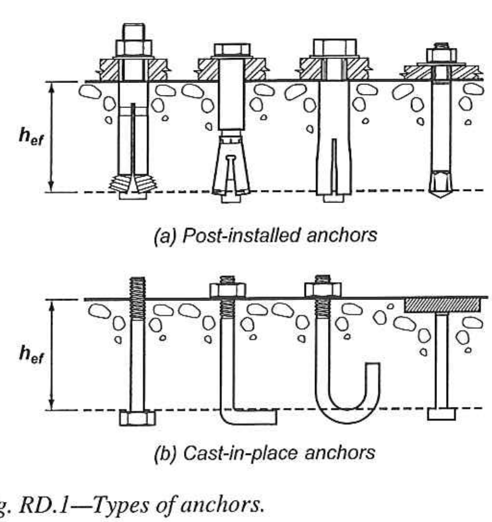
Five percent fractile — A statistical term meaning 90 percent confidence that there is 95 percent probability of the actual strength exceeding the nominal strength.

Headed stud — A steel anchor conforming to the requirements of AWS D1.1 and affixed to a plate or similar steel attachment by the stud arc welding process before casting.

COMMENTARY

Effective embedment depth — Effective embedment depths for a variety of anchor types are shown in Fig. RD.1.

Five percent fractile — The determination of the coefficient K_{05} associated with the 5 percent fractile, $\bar{x} - K_{05}s_s$ depends on the number of tests, n, used to compute the sample mean, $\bar{x}$, and sample standard deviation, s_s. Values of K_{05} range, for example, from 1.645 for $n = \infty$, to 2.010 for n = **40**, and 2.568 for n = **10**. With this definition of the 5 percent fractile, the nominal strength in D.4.2 is the same as the characteristic strength in ACI 355.2.



(a) Post-installed anchors

(b) Cast-in-place anchors

Fig. RD.1—Types of anchors.

Table 34-1 Properties of Cast-in-Place Anchor Materials

Material specification[1]	Grade or type	Diameter (in.)	Tensile strength, for design f_{ut} (ksi)	Tensile strength, min. (ksi)	Yield strength, min.		Elongation, min.		Reduction of area, min., (%)
					ksi	method	%	length	
AWS D1.1[2]	B	1/2 – 1	60	60	50	0.2%	20	2"	50
ASTM A307[3]	A C	≤ 4 ≤ 4	60 58	60 58-80	— 36	— —	18 23	2" 2"	— —
ASTM A354[4]	BC BD	≤ 4 ≤ 4	125 125	125 150	109 130	0.2% 0.2%	16 14	2" 2"	50 40
ASTM A449[5]	1	≤ 1 1 – 1-1/2 > 1-1/2	120 105 90	120 105 90	92 81 58	0.2% 0.2% 0.2%	14 14 14	4D 4D 4D	35 35 35
ASTM F1554[6]	36 55 105	≤ 2 ≤ 2 ≤ 2	58 75 125	58-80 75-95 125-150	36 55 105	0.2% 0.2% 0.2%	23 21 15	2" 2" 2"	40 30 45

Notes:

1. The materials listed are commonly used for concrete anchors. Although other materials may be used (e.g., ASTM A193 for high temperature applications, ASTM A320 for low temperature applications), those listed are preferred for normal use. Structural steel bolting materials such as ASTM A325 and ASTM A490 are not typically available in the lengths needed for concrete anchorage applications.
2. AWS D1.1-06 Structural Welding Code - Steel - This specification covers welded headed studs or welded hooked studs (unthreaded). None of the other listed specifications cover welded studs.
3. ASTM A307-07a Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength - This material is commonly used for concrete anchorage applications. Grade A is headed bolts and studs. Grade C is nonheaded bolts (studs), either straight or bent, and is equivalent to ASTM A36 steel. Note that although a reduction in area requirement is not provided, A307 may be considered a ductile steel element. Under the definition of "Ductile steel element" in D.1, the code states: "A steel element meeting the requirements of ASTM A307 shall be considered ductile."
4. ASTM A354-07a Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners - The strength of Grade BD is equivalent to ASTM A490.
5. ASTM A449-07b Standard Specification for Quenched and Tempered Steel Bolts and Studs - This specification is referenced by ASTM A325 for "equivalent" anchor bolts.
6. ASTM F1554-07a Standard Specification for Anchor Bolts - This specification covers straight and bent, headed and headless, anchor bolts in three strength grades. Anchors are available in diameters ≤ 4 in. but reduction in area requirements vary for anchors > 2 in.

Table 34-2 Dimensional Properties of Threaded Cast-in-Place Anchors

Anchor Diameter (d_a) (in.)	Gross Area of Anchor (in.^{2})	Effective Area of Anchor ($A_{se,N}$, $A_{se,V}$) (in.^{2})	Bearing Area of Heads and Nuts (A_{brg}) (in.^{2})			
			Square	Heavy Square	Hex	Heavy Hex
0.250	0.049	0.032	0.142	0.201	0.117	0.167
0.375	0.110	0.078	0.280	0.362	0.164	0.299
0.500	0.196	0.142	0.464	0.569	0.291	0.467
0.625	0.307	0.226	0.693	0.822	0.454	0.671
0.750	0.442	0.334	0.824	1.121	0.654	0.911
0.875	0.601	0.462	1.121	1.465	0.891	1.188
1.000	0.785	0.606	1.465	1.855	1.163	1.501
1.125	0.994	0.763	1.854	2.291	1.472	1.851
1.250	1.227	0.969	2.228	2.773	1.817	2.237
1.375	1.485	1.160	2.769	3.300	2.199	2.659
1.500	1.767	1.410	3.295	3.873	2.617	3.118
1.750	2.405	1.900	—	—	—	4.144
2.000	3.142	2.500	—	—	—	5.316

CODE

COMMENTARY

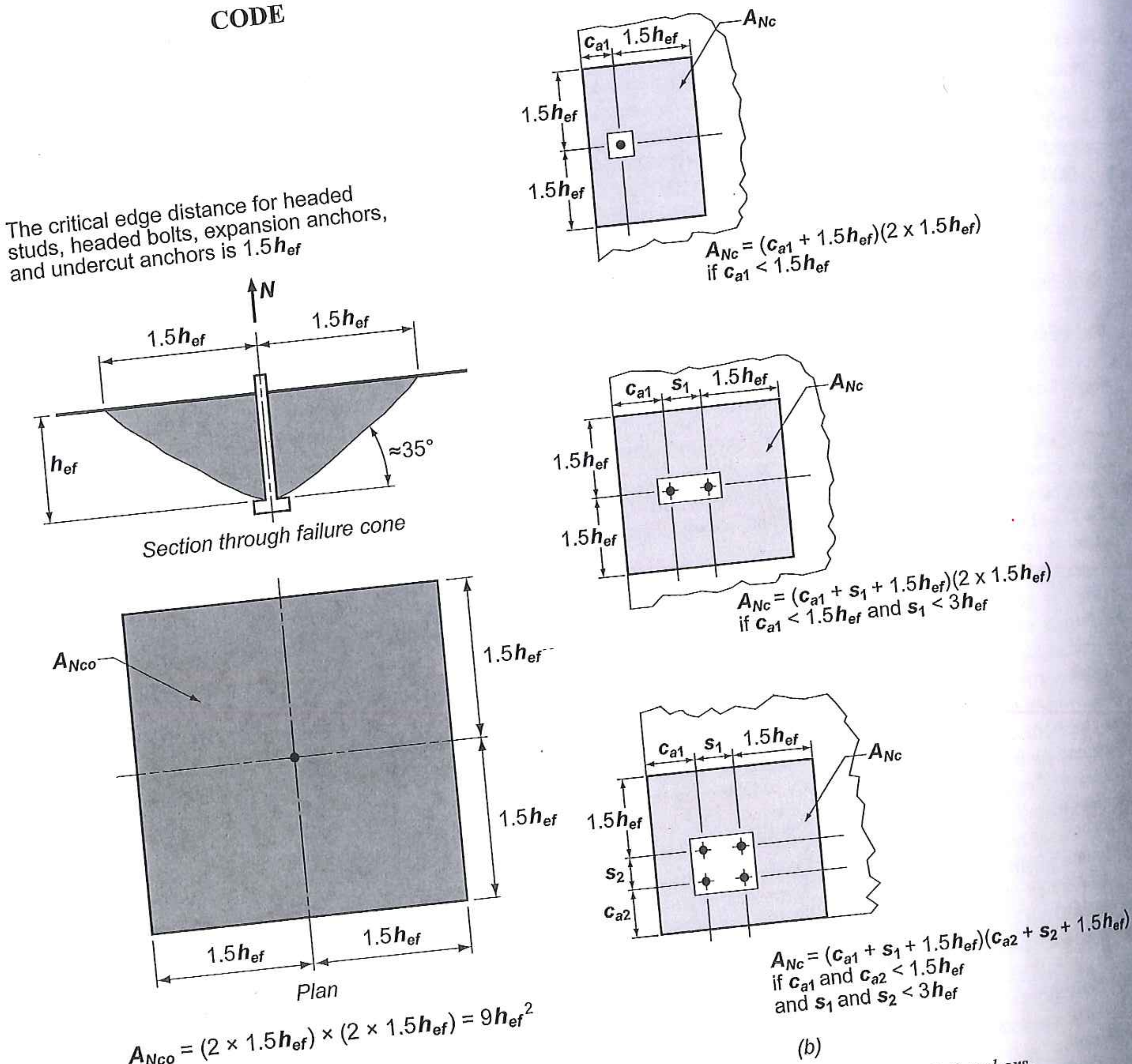


***Fig. R17.4.2.1**—(a) Calculation of* A_{Nco} *and (b) calculation of* A_{Nc} *for single anchors and groups of anchors.*

17.4.2.2 The basic concrete breakout strength of a single anchor in tension in cracked concrete, N_b, shall not exceed

$$N_b = k_c \lambda_a \sqrt{f_c'}\, h_{ef}^{1.5} \qquad (17.4.2.2a)$$

where k_c = **24** for cast-in anchors and 17 for post-installed anchors.

The value of k_c for post-installed anchors shall be permitted to be increased above 17 based on ACI 355.2 or ACI 355.4 product-specific tests, but shall not exceed 24.

Alternatively, for cast-in headed studs and headed bolts with ... $h_{ef} \leq$ **25 in.**, N_b shall not exceed

R17.4.2.2 The equation for the basic concrete breakout strength was derived (Fuchs et al. 1995; Eligehausen and Balogh 1995; Eligehausen and Fuchs 1988; CEB 1994) assuming a concrete failure prism with an angle of approximately 35 degrees, considering fracture mechanics concepts.

The values of k_c in Eq. (17.4.2.2a) were determined from a large database of test results in uncracked concrete (Fuchs et al. 1995) at the 5 percent fractile. The values were adjusted to corresponding k_c values for cracked concrete (Eligehausen and Balogh 1995; Goto 1971). Tests have shown that the values of k_c applicable to adhesive anchors are approximately equal to those derived for expansion anchors (Eligehausen et al. 2006a; Zhang et al. 2001). Higher k_c values for

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COMMENTARY

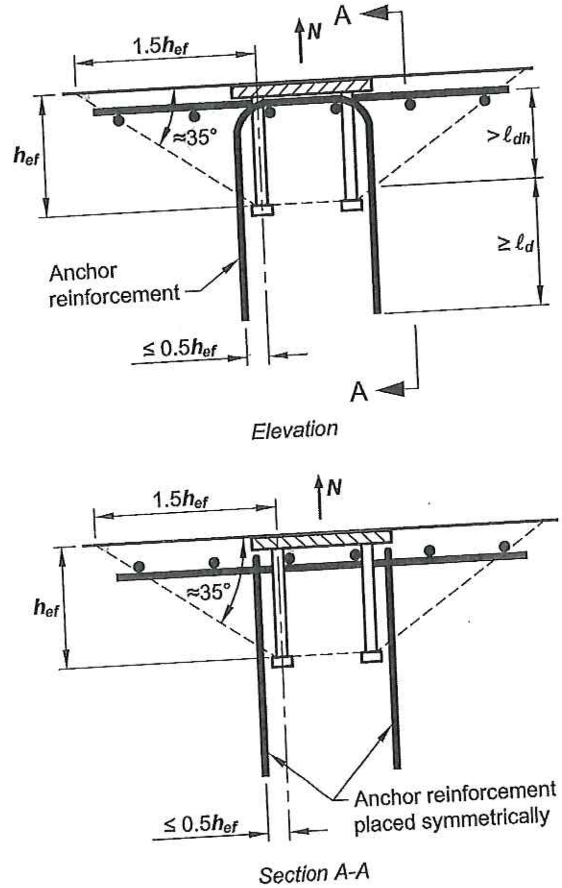

***Fig. R17.4.2.9**—Anchor reinforcement for tension.*

17.4.3 *Pullout strength of cast-in, post-installed expansion and undercut anchors in tension*

17.4.3.1 The nominal pullout strength of a single cast-in, post-installed expansion, and post-installed undercut anchor in tension, N_{pn}, shall not exceed

$$N_{pn} = \psi_{c,P} N_p \qquad (17.4.3.1)$$

where $\psi_{c,P}$ is defined in 17.4.3.6.

17.4.3.2 For post-installed expansion and undercut anchors, the values of N_p shall be based on the 5 percent fractile of results of tests performed and evaluated according to ACI 355.2. It is not permissible to calculate the pullout strength in tension for such anchors.

17.4.3.3 For single cast-in headed studs and headed bolts, it shall be permitted to evaluate the pullout strength in tension using 17.4.3.4. For single J- or L-bolts, it shall be permitted to evaluate the pullout strength in tension using 17.4.3.5. Alternatively, it shall be permitted to use values of N_p based on the 5 percent fractile of tests performed and

R17.4.3 *Pullout strength of cast-in, post-installed expansion and undercut anchors in tension*

R17.4.3.1 The design requirements for pullout are applicable to cast-in, post-installed expansion, and post-installed undercut anchors. They are not applicable to adhesive anchors, which are instead evaluated for bond failure in accordance with 17.4.5.

R17.4.3.2 The pullout strength equations given in 17.4.3.4 and 17.4.3.5 are only applicable to cast-in headed and hooked anchors (CEB 1997; Kuhn and Shaikh 1996); they are not applicable to expansion and undercut anchors that use various mechanisms for end anchorage unless the validity of the pullout strength equations are verified by tests.

R17.4.3.3 The pullout strength in tension of headed studs or headed bolts can be increased by providing confining reinforcement, such as closely spaced spirals, throughout the head region. This increase can be demonstrated by tests.

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COMMENTARY

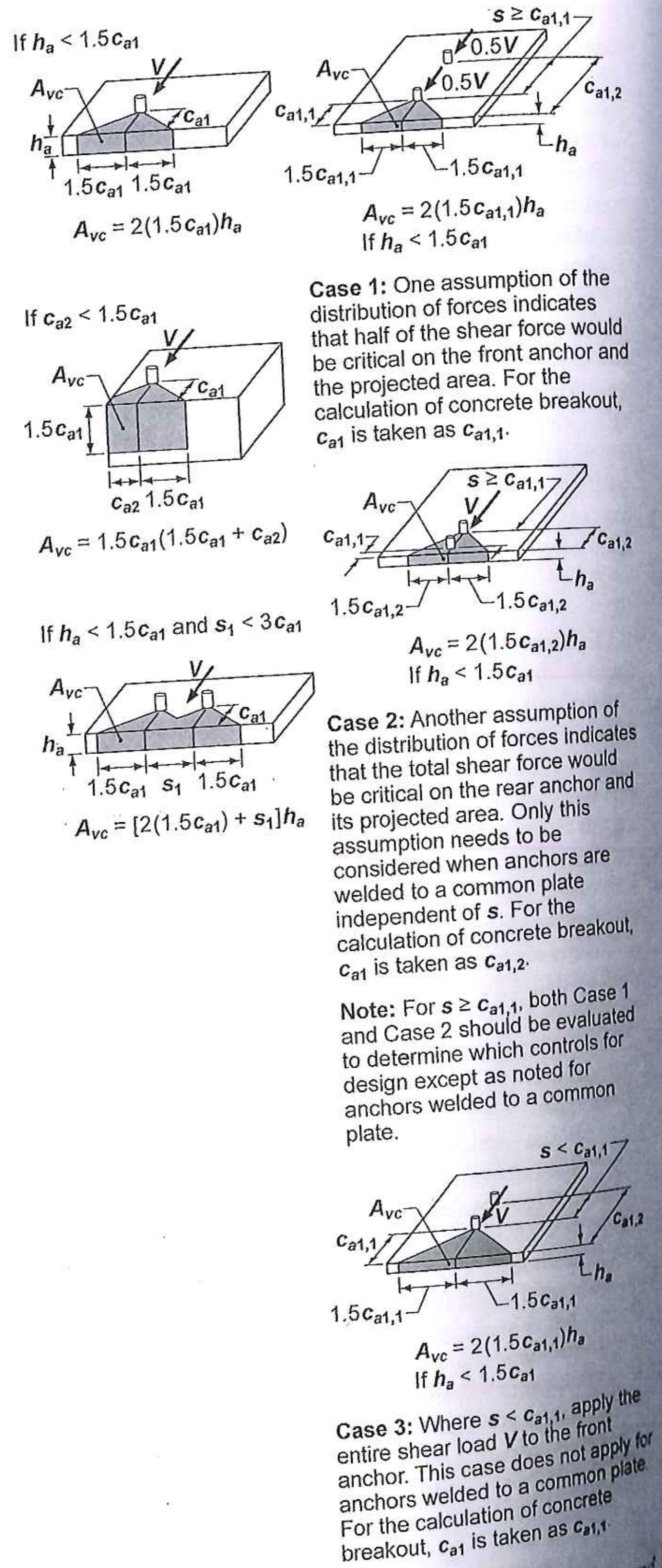

Fig. R17.5.2.1b—Calculation of A_{vc} for single anchors and groups of anchors.

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COMMENTARY

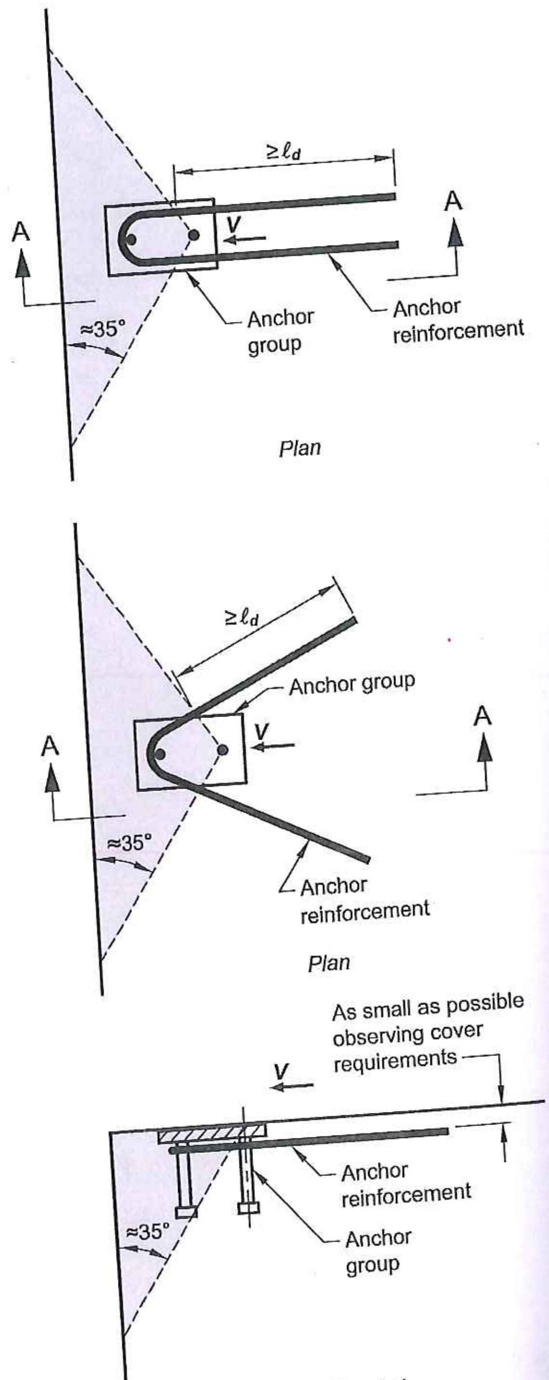

***Fig. R17.5.2.9a**—Hairpin anchor reinforcement for shear.*

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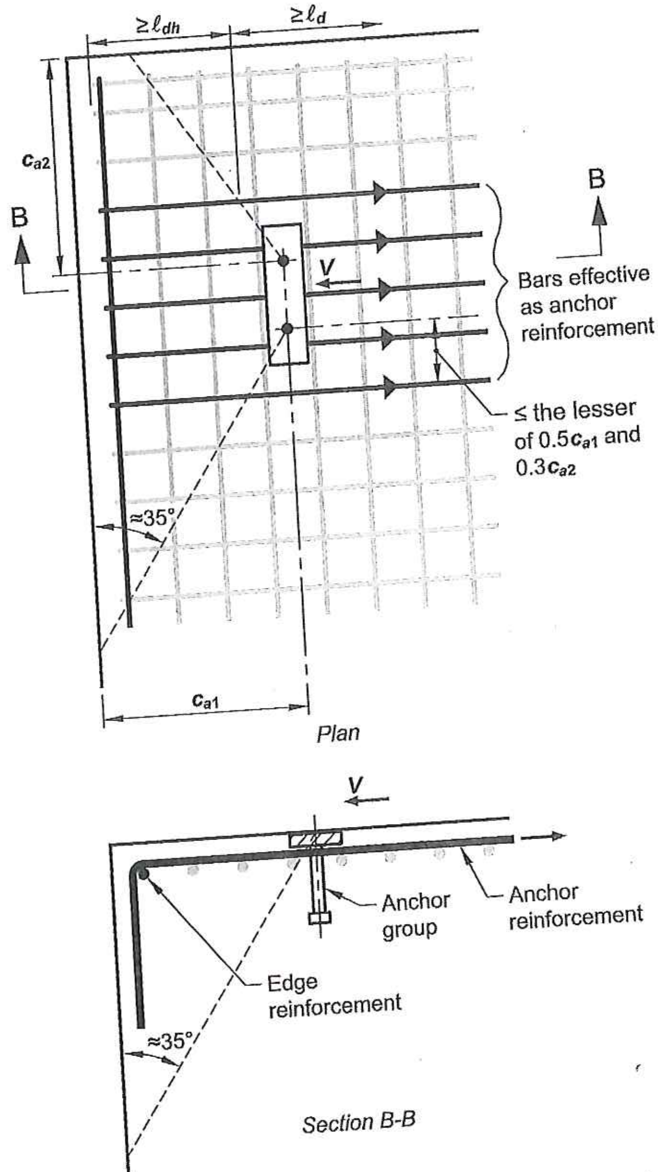


Fig. R17.5.2.9b—Edge reinforcement and anchor reinforcement for shear.

17.5.3 *Concrete pryout strength of anchor in shear*

17.5.3.1 The nominal pryout strength, V_{cp} for a single anchor or V_{cpg} for a group of anchors, shall not exceed:

(a) For a single anchor

$$V_{cp} = k_{cp} N_{cp} \tag{17.5.3.1a}$$

For cast-in, expansion, and undercut anchors, N_{cp} shall be taken as N_{cb} determined from Eq. (17.4.2.1a), and for adhesive anchors, N_{cp} shall be the lesser of N_a determined from Eq. (17.4.5.1a) and N_{cb} determined from Eq. (17.4.2.1a).

(b) For a group of anchors

R17.5.3 *Concrete pryout strength of anchor in shear*

R17.5.3.1 Fuchs et al. (1995) indicates that the pryout shear resistance can be approximated as one to two times the anchor tensile resistance with the lower value appropriate for h_{ef} less than 2.5 in. Because it is possible that the bond strength of adhesive anchors could be less than the concrete breakout strength, it is necessary to consider both 17.4.2.1 and 17.4.5.1 for determination of the pryout strength.

17

Sum-It: AASHTO LRFD Load Combination Generator
Figg Bridge Engineers, Inc.
Combined Limit States Summary
File Name: Pylon Anchor Forces_Member End Forces_Global.sum

Selected Limit States

STR 1 - STRENGTH I
STR 3 - STRENGTH III

Max/ Min ID	Load Num	Member Num	Joint Num	Limit State/ Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
Max Fx	6	601	411	STR 3/ 240	354.2	-6.4	-269.8	-72.7	-137.0	-83.9	155.1	111.0	160.6
Max Fy	5	505	407	STR 1/ 9	138.5	0.2	182.4	0.7	36.8	-0.9	36.8	1.1	36.8
Max Fz	5	505	407	STR 1/ 28	268.1	0.0	348.0	0.0	52.2	0.0	52.2	0.0	52.2
Max Mx	1	501	411	STR 1/ 8	-69.5	-0.2	-10.3	1.6	491.4	6.7	491.4	6.8	491.5
Max My	1	501	411	STR 3/ 55	-387.9	-5.0	-150.9	-52.1	586.1	113.8	588.4	125.2	597.0
Max Mz	1	501	411	STR 3/ 10	-66.9	-10.4	-9.2	-103.7	487.7	237.4	498.6	259.1	542.4
Max Mxy	1	501	411	STR 3/ 55	-387.9	-5.0	-150.9	-52.1	586.1	113.8	588.4	125.2	597.0
Max Mxz	1	501	411	STR 3/ 10	-66.9	-10.4	-9.2	-103.7	487.7	237.4	498.6	259.1	542.4
Max Myz	1	501	411	STR 3/ 55	-387.9	-5.0	-150.9	-52.1	586.1	113.8	588.4	125.2	597.0
Min Fx	1	501	411	STR 1/ 155	-398.8	0.0	-159.9	0.0	503.4	0.0	503.4	0.0	503.4
Min Fy	1	501	411	STR 3/ 10	-66.9	-10.4	-9.2	-103.7	487.7	237.4	498.6	259.1	542.4
Min Fz	6	601	411	STR 3/ 240	354.2	-6.4	-269.8	-72.7	-137.0	-83.9	155.1	111.0	160.6
Min Mx	1	501	411	STR 3/ 1	-63.5	-10.2	-7.7	-105.0	487.6	231.8	498.8	254.5	539.9
Min My	6	601	411	STR 3/ 119	341.8	-3.2	-251.7	-35.4	-238.0	-40.6	240.6	53.9	241.4
Min Mz	6	601	411	STR 3/ 10	34.7	-6.4	-13.7	-72.7	-180.5	-83.9	194.6	111.0	199.0
Min Mxy	10	605	407	STR 1/ 65	-89.6	0.0	115.9	0.0	-13.4	0.0	13.4	0.0	13.4
Min Mxz	1	501	411	STR 1/ 1	-54.6	0.0	-3.5	0.0	493.2	0.0	493.2	0.0	493.2
Min Myz	10	605	407	STR 3/ 135	-49.7	-1.3	63.6	-13.3	-7.5	-5.7	15.3	14.5	9.4

Selected Limit States

STR 1 - STRENGTH I
STR 3 - STRENGTH III

Combinded Results

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
Load No. 1 **Member** 501 **Joint** 411	Max Fx	STR 1/ 57	-41.4	0.0	-3.4	0.0	350.7	0.0	350.7	0.0	350.7
	Max Fy	STR 1/ 1	-54.6	0.0	-3.5	0.0	493.2	0.0	493.2	0.0	493.2
	Max Fz	STR 1/ 3	-42.9	0.0	1.8	0.0	485.3	0.0	485.3	0.0	485.3
	Max Mx	STR 1/ 8	-69.5	-0.2	-10.3	1.6	491.4	6.7	491.4	6.8	491.5
	Max My	STR 3/ 55	-387.9	-5.0	-150.9	-52.1	586.1	113.8	588.4	125.2	597.0
	Max Mz	STR 3/ 10	-66.9	-10.4	-9.2	-103.7	487.7	237.4	498.6	259.1	542.4
	Max Mxy	STR 3/ 55	-387.9	-5.0	-150.9	-52.1	586.1	113.8	588.4	125.2	597.0
	Max Mxz	STR 3/ 10	-66.9	-10.4	-9.2	-103.7	487.7	237.4	498.6	259.1	542.4
	Max Myz	STR 3/ 55	-387.9	-5.0	-150.9	-52.1	586.1	113.8	588.4	125.2	597.0
	Min Fx	STR 1/ 155	-398.8	0.0	-159.9	0.0	503.4	0.0	503.4	0.0	503.4
	Min Fy	STR 3/ 10	-66.9	-10.4	-9.2	-103.7	487.7	237.4	498.6	259.1	542.4
	Min Fz	STR 1/ 209	-397.3	0.0	-165.1	0.0	368.9	0.0	368.9	0.0	368.9
	Min Mx	STR 3/ 1	-63.5	-10.2	-7.7	-105.0	487.6	231.8	498.8	254.5	539.9
	Min My	STR 3/ 199	-139.5	-5.0	-52.2	-52.1	261.9	113.8	267.0	125.2	285.6
	Min Mz	STR 1/ 9	-53.2	0.0	-3.0	-0.4	486.5	-0.2	486.5	0.4	486.5
	Min Mxy	STR 3/ 199	-139.5	-5.0	-52.2	-52.1	261.9	113.8	267.0	125.2	285.6
	Min Mxz	STR 1/ 1	-54.6	0.0	-3.5	0.0	493.2	0.0	493.2	0.0	493.2
	Min Myz	STR 3/ 199	-139.5	-5.0	-52.2	-52.1	261.9	113.8	267.0	125.2	285.6
Load No. 2 **Member** 502 **Joint** 410	Max Fx	STR 1/ 1	93.4	0.0	64.9	0.0	330.9	0.0	330.9	0.0	330.9
	Max Fy	STR 1/ 1	93.4	0.0	64.9	0.0	330.9	0.0	330.9	0.0	330.9
	Max Fz	STR 1/ 1	93.4	0.0	64.9	0.0	330.9	0.0	330.9	0.0	330.9
	Max Mx	STR 1/ 8	51.3	-0.2	43.5	0.9	328.5	6.7	328.5	6.7	328.5
	Max My	STR 3/ 55	-132.8	-4.1	-45.8	-38.4	398.6	73.9	400.4	83.3	405.4
	Max Mz	STR 3/ 10	11.9	-8.4	23.5	-76.7	320.4	156.9	329.4	174.7	356.7
	Max Mxy	STR 3/ 55	-132.8	-4.1	-45.8	-38.4	398.6	73.9	400.4	83.3	405.4
	Max Mxz	STR 3/ 10	11.9	-8.4	23.5	-76.7	320.4	156.9	329.4	174.7	356.7
	Max Myz	STR 3/ 55	-132.8	-4.1	-45.8	-38.4	398.6	73.9	400.4	83.3	405.4
	Min Fx	STR 3/ 240	-162.7	-8.4	-69.4	-76.7	242.4	156.9	254.3	174.7	288.8
	Min Fy	STR 3/ 1	29.7	-8.4	32.5	-77.4	323.0	151.5	332.2	170.1	356.8
	Min Fz	STR 3/ 240	-162.7	-8.4	-69.4	-76.7	242.4	156.9	254.3	174.7	288.8
	Min Mx	STR 3/ 1	29.7	-8.4	32.5	-77.4	323.0	151.5	332.2	170.1	356.8
	Min My	STR 3/ 199	-37.4	-4.1	-9.9	-38.4	169.1	73.9	173.4	83.3	184.6
	Min Mz	STR 1/ 9	40.1	0.0	37.6	-0.4	321.6	-0.4	321.6	0.5	321.6
	Min Mxy	STR 3/ 199	-37.4	-4.1	-9.9	-38.4	169.1	73.9	173.4	83.3	184.6
	Min Mxz	STR 1/ 1	93.4	0.0	64.9	0.0	330.9	0.0	330.9	0.0	330.9
	Min Myz	STR 3/ 199	-37.4	-4.1	-9.9	-38.4	169.1	73.9	173.4	83.3	184.6

FIGG

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 1/ 1	176.9	0.0	118.2	0.0	200.7	0.0	200.7	0.0	200.7
	Max Fy	STR 1/ 1	176.9	0.0	118.2	0.0	200.7	0.0	200.7	0.0	200.7
	Max Fz	STR 1/ 1	176.9	0.0	118.2	0.0	200.7	0.0	200.7	0.0	200.7
	Max Mx	STR 1/ 1	176.9	0.0	118.2	0.0	200.7	0.0	200.7	0.0	200.7
	Max My	STR 3/ 55	18.9	-3.2	28.3	-27.0	247.8	42.3	249.2	50.2	251.4
Load No.	Max Mz	STR 3/ 10	60.2	-6.6	49.1	-54.7	191.2	92.7	198.9	107.6	212.5
3	Max Mxy	STR 3/ 55	18.9	-3.2	28.3	-27.0	247.8	42.3	249.2	50.2	251.4
	Max Mxz	STR 3/ 10	60.2	-6.6	49.1	-54.7	191.2	92.7	198.9	107.6	212.5
Member	Max Myz	STR 3/ 55	18.9	-3.2	28.3	-27.0	247.8	42.3	249.2	50.2	251.4
503	Min Fx	STR 3/ 240	-27.0	-6.6	-6.0	-54.7	149.6	92.7	159.3	107.6	176.0
	Min Fy	STR 3/ 10	60.2	-6.6	49.1	-54.7	191.2	92.7	198.9	107.6	212.5
Joint	Min Fz	STR 3/ 240	-27.0	-6.6	-6.0	-54.7	149.6	92.7	159.3	107.6	176.0
409	Min Mx	STR 3/ 1	85.6	-6.4	64.1	-54.7	193.3	87.2	200.9	103.0	212.1
	Min My	STR 3/ 199	25.4	-3.2	21.5	-27.0	96.4	42.3	100.1	50.2	105.2
	Min Mz	STR 1/ 9	96.4	0.0	70.6	-0.4	191.8	-0.5	191.8	0.6	191.8
	Min Mxy	STR 3/ 199	25.4	-3.2	21.5	-27.0	96.4	42.3	100.1	50.2	105.2
	Min Mxz	STR 1/ 1	176.9	0.0	118.2	0.0	200.7	0.0	200.7	0.0	200.7
	Min Myz	STR 3/ 199	25.4	-3.2	21.5	-27.0	96.4	42.3	100.1	50.2	105.2
	Max Fx	STR 1/ 28	251.3	0.0	201.6	0.0	116.8	0.0	116.8	0.0	116.8
	Max Fy	STR 1/ 1	221.2	0.0	178.4	0.0	105.4	0.0	105.4	0.0	105.4
	Max Fz	STR 1/ 28	251.3	0.0	201.6	0.0	116.8	0.0	116.8	0.0	116.8
	Max Mx	STR 1/ 1	221.2	0.0	178.4	0.0	105.4	0.0	105.4	0.0	105.4
	Max My	STR 3/ 35	151.9	-2.2	128.8	-18.1	136.3	18.8	137.5	26.0	137.6
Load No.	Max Mz	STR 3/ 10	91.7	-4.8	79.7	-37.9	96.8	45.4	103.9	59.1	106.9
4	Max Mxy	STR 3/ 35	151.9	-2.2	128.8	-18.1	136.3	18.8	137.5	26.0	137.6
	Max Mxz	STR 3/ 10	91.7	-4.8	79.7	-37.9	96.8	45.4	103.9	59.1	106.9
Member	Max Myz	STR 3/ 35	151.9	-2.2	128.8	-18.1	136.3	18.8	137.5	26.0	137.6
504	Min Fx	STR 3/ 210	24.1	-4.8	25.5	-37.9	70.4	45.4	80.0	59.1	83.8
	Min Fy	STR 3/ 10	91.7	-4.8	79.7	-37.9	96.8	45.4	103.9	59.1	106.9
Joint	Min Fz	STR 3/ 210	24.1	-4.8	25.5	-37.9	70.4	45.4	80.0	59.1	83.8
408	Min Mx	STR 3/ 10	91.7	-4.8	79.7	-37.9	96.8	45.4	103.9	59.1	106.9
	Min My	STR 3/ 199	61.9	-2.2	51.3	-18.1	45.0	18.8	48.5	26.0	48.7
	Min Mz	STR 1/ 9	130.8	0.0	109.4	0.0	97.2	-0.9	97.2	0.9	97.2
	Min Mxy	STR 3/ 199	61.9	-2.2	51.3	-18.1	45.0	18.8	48.5	26.0	48.7
	Min Mxz	STR 1/ 1	221.2	0.0	178.4	0.0	105.4	0.0	105.4	0.0	105.4
	Min Myz	STR 3/ 199	61.9	-2.2	51.3	-18.1	45.0	18.8	48.5	26.0	48.7

Combinded Results

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 1/ 28	268.1	0.0	348.0	0.0	52.2	0.0	52.2	0.0	52.2
	Max Fy	STR 1/ 9	138.5	0.2	182.4	0.7	36.8	-0.9	36.8	1.1	36.8
	Max Fz	STR 1/ 28	268.1	0.0	348.0	0.0	52.2	0.0	52.2	0.0	52.2
	Max Mx	STR 1/ 9	138.5	0.2	182.4	0.7	36.8	-0.9	36.8	1.1	36.8
	Max My	STR 3/ 35	176.8	-1.3	235.1	-11.5	61.3	3.6	62.3	12.0	61.4
Load No.	Max Mz	STR 3/ 10	110.0	-2.9	146.3	-26.6	36.7	12.6	45.3	29.4	38.8
5	Max Mxy	STR 3/ 35	176.8	-1.3	235.1	-11.5	61.3	3.6	62.3	12.0	61.4
	Max Mxz	STR 3/ 10	110.0	-2.9	146.3	-26.6	36.7	12.6	45.3	29.4	38.8
Member	Max Myz	STR 3/ 35	176.8	-1.3	235.1	-11.5	61.3	3.6	62.3	12.0	61.4
505	Min Fx	STR 3/ 210	24.4	-2.9	35.5	-26.6	25.0	12.6	36.5	29.4	28.0
	Min Fy	STR 3/ 10	110.0	-2.9	146.3	-26.6	36.7	12.6	45.3	29.4	38.8
Joint	Min Fz	STR 3/ 210	24.4	-2.9	35.5	-26.6	25.0	12.6	36.5	29.4	28.0
407	Min Mx	STR 3/ 10	110.0	-2.9	146.3	-26.6	36.7	12.6	45.3	29.4	38.8
	Min My	STR 3/ 199	59.0	-1.3	76.3	-11.5	11.8	3.6	16.5	12.0	12.4
	Min Mz	STR 1/ 9	138.5	0.2	182.4	0.7	36.8	-0.9	36.8	1.1	36.8
	Min Mxy	STR 3/ 199	59.0	-1.3	76.3	-11.5	11.8	3.6	16.5	12.0	12.4
	Min Mxz	STR 1/ 1	218.9	0.0	285.0	0.0	42.5	0.0	42.5	0.0	42.5
	Min Myz	STR 3/ 199	59.0	-1.3	76.3	-11.5	11.8	3.6	16.5	12.0	12.4
	Max Fx	STR 3/ 240	354.2	-6.4	-269.8	-72.7	-137.0	-83.9	155.1	111.0	160.6
	Max Fy	STR 1/ 1	-18.8	0.0	28.5	0.0	-173.1	0.0	173.1	0.0	173.1
	Max Fz	STR 1/ 1	-18.8	0.0	28.5	0.0	-173.1	0.0	173.1	0.0	173.1
	Max Mx	STR 1/ 1	-18.8	0.0	28.5	0.0	-173.1	0.0	173.1	0.0	173.1
	Max My	STR 3/ 125	22.6	-3.2	-12.5	-35.4	-76.2	-40.6	84.0	53.9	86.3
Load No.	Max Mz	STR 1/ 8	4.3	0.0	10.1	-0.2	-173.6	1.6	173.6	1.6	173.6
6	Max Mxy	STR 3/ 119	341.8	-3.2	-251.7	-35.4	-238.0	-40.6	240.6	53.9	241.4
	Max Mxz	STR 3/ 10	34.7	-6.4	-13.7	-72.7	-180.5	-83.9	194.6	111.0	199.0
Member	Max Myz	STR 3/ 119	341.8	-3.2	-251.7	-35.4	-238.0	-40.6	240.6	53.9	241.4
601	Min Fx	STR 1/ 1	-18.8	0.0	28.5	0.0	-173.1	0.0	173.1	0.0	173.1
	Min Fy	STR 3/ 1	22.5	-6.4	-4.1	-71.8	-178.8	-82.3	192.7	109.2	196.9
Joint	Min Fz	STR 3/ 240	354.2	-6.4	-269.8	-72.7	-137.0	-83.9	155.1	111.0	160.6
411	Min Mx	STR 3/ 10	34.7	-6.4	-13.7	-72.7	-180.5	-83.9	194.6	111.0	199.0
	Min My	STR 3/ 119	341.8	-3.2	-251.7	-35.4	-238.0	-40.6	240.6	53.9	241.4
	Min Mz	STR 3/ 10	34.7	-6.4	-13.7	-72.7	-180.5	-83.9	194.6	111.0	199.0
	Min Mxy	STR 3/ 125	22.6	-3.2	-12.5	-35.4	-76.2	-40.6	84.0	53.9	86.3
	Min Mxz	STR 1/ 1	-18.8	0.0	28.5	0.0	-173.1	0.0	173.1	0.0	173.1
	Min Myz	STR 3/ 125	22.6	-3.2	-12.5	-35.4	-76.2	-40.6	84.0	53.9	86.3

Sum-It: AASHTO LRFD Load Combination Generator
Figg Bridge Engineers, Inc.
Combined Limit States Results
File Name: Pylon Anchor Forces_Member End Forces_Global.sum

Combinded Results

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 3/ 240	158.7	-5.5	-124.4	-58.2	-100.8	-60.3	116.5	83.9	117.5
	Max Fy	STR 1/ 8	-56.4	0.2	59.3	0.2	-124.1	1.8	124.1	1.8	124.1
	Max Fz	STR 1/ 1	-96.0	0.0	92.3	0.0	-123.6	0.0	123.6	0.0	123.6
	Max Mx	STR 1/ 8	-56.4	0.2	59.3	0.2	-124.1	1.8	124.1	1.8	124.1
	Max My	STR 3/ 125	-28.5	-2.7	28.7	-28.4	-54.2	-29.1	61.2	40.7	61.5
Load No.	Max Mz	STR 1/ 8	-56.4	0.2	59.3	0.2	-124.1	1.8	124.1	1.8	124.1
7	Max Mxy	STR 3/ 119	134.9	-2.7	-97.1	-28.4	-174.9	-29.1	177.2	40.7	177.3
	Max Mxz	STR 3/ 10	-17.7	-5.5	26.8	-58.2	-132.2	-60.3	144.4	83.9	145.3
Member	Max Myz	STR 3/ 119	134.9	-2.7	-97.1	-28.4	-174.9	-29.1	177.2	40.7	177.3
602	Min Fx	STR 1/ 1	-96.0	0.0	92.3	0.0	-123.6	0.0	123.6	0.0	123.6
	Min Fy	STR 3/ 1	-35.1	-5.5	41.4	-57.5	-130.2	-59.1	142.3	82.5	143.0
Joint	Min Fz	STR 3/ 240	158.7	-5.5	-124.4	-58.2	-100.8	-60.3	116.5	83.9	117.5
410	Min Mx	STR 3/ 10	-17.7	-5.5	26.8	-58.2	-132.2	-60.3	144.4	83.9	145.3
	Min My	STR 3/ 119	134.9	-2.7	-97.1	-28.4	-174.9	-29.1	177.2	40.7	177.3
	Min Mz	STR 3/ 10	-17.7	-5.5	26.8	-58.2	-132.2	-60.3	144.4	83.9	145.3
	Min Mxy	STR 3/ 125	-28.5	-2.7	28.7	-28.4	-54.2	-29.1	61.2	40.7	61.5
	Min Mxz	STR 1/ 1	-96.0	0.0	92.3	0.0	-123.6	0.0	123.6	0.0	123.6
	Min Myz	STR 3/ 125	-28.5	-2.7	28.7	-28.4	-54.2	-29.1	61.2	40.7	61.5
	Max Fx	STR 3/ 240	32.7	-4.5	-22.6	-45.8	-67.6	-40.0	81.6	60.8	78.5
	Max Fy	STR 1/ 7	-112.3	0.2	112.4	0.0	-85.7	0.9	85.7	0.9	85.7
	Max Fz	STR 1/ 1	-149.8	0.0	146.3	0.0	-82.5	0.0	82.5	0.0	82.5
	Max Mx	STR 1/ 8	-99.7	0.2	100.7	0.5	-82.9	1.9	82.9	2.0	82.9
	Max My	STR 3/ 135	-24.3	-2.2	25.6	-22.3	-34.7	-19.3	41.2	29.5	39.7
Load No.	Max Mz	STR 1/ 8	-99.7	0.2	100.7	0.5	-82.9	1.9	82.9	2.0	82.9
8	Max Mxy	STR 3/ 99	-58.4	-2.2	67.0	-22.3	-119.4	-19.3	121.4	29.5	120.9
	Max Mxz	STR 3/ 10	-53.7	-4.5	58.9	-45.8	-90.6	-40.0	101.5	60.8	99.1
Member	Max Myz	STR 3/ 99	-58.4	-2.2	67.0	-22.3	-119.4	-19.3	121.4	29.5	120.9
603	Min Fx	STR 1/ 1	-149.8	0.0	146.3	0.0	-82.5	0.0	82.5	0.0	82.5
	Min Fy	STR 3/ 1	-74.9	-4.5	78.3	-45.2	-88.8	-39.2	99.7	59.8	97.1
Joint	Min Fz	STR 3/ 240	32.7	-4.5	-22.6	-45.8	-67.6	-40.0	81.6	60.8	78.5
409	Min Mx	STR 3/ 10	-53.7	-4.5	58.9	-45.8	-90.6	-40.0	101.5	60.8	99.1
	Min My	STR 3/ 99	-58.4	-2.2	67.0	-22.3	-119.4	-19.3	121.4	29.5	120.9
	Min Mz	STR 3/ 10	-53.7	-4.5	58.9	-45.8	-90.6	-40.0	101.5	60.8	99.1
	Min Mxy	STR 3/ 135	-24.3	-2.2	25.6	-22.3	-34.7	-19.3	41.2	29.5	39.7
	Min Mxz	STR 1/ 1	-149.8	0.0	146.3	0.0	-82.5	0.0	82.5	0.0	82.5
	Min Myz	STR 3/ 135	-24.3	-2.2	25.6	-22.3	-34.7	-19.3	41.2	29.5	39.7

	Combined Results										
	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
Load No. 9 **Member** 604 **Joint** 408	Max Fx	STR 3/ 210	-13.9	-3.5	20.1	-35.3	-41.0	-23.7	54.1	42.5	47.4
	Max Fy	STR 1/ 7	-145.2	0.2	157.3	0.7	-52.6	1.9	52.6	2.0	52.6
	Max Fz	STR 1/ 28	-212.0	0.0	226.0	0.0	-49.1	0.0	49.1	0.0	49.1
	Max Mx	STR 1/ 8	-129.0	0.2	140.5	0.9	-50.3	2.1	50.3	2.3	50.4
	Max My	STR 3/ 165	-80.4	-1.7	85.0	-17.2	-17.9	-11.3	24.8	20.6	21.2
	Max Mz	STR 1/ 8	-129.0	0.2	140.5	0.9	-50.3	2.1	50.3	2.3	50.4
	Max Mxy	STR 3/ 69	-96.6	-1.7	110.7	-17.2	-75.8	-11.3	77.7	20.6	76.6
	Max Mxz	STR 3/ 10	-80.8	-3.5	91.2	-35.3	-56.8	-23.7	66.8	42.5	61.5
	Max Myz	STR 3/ 69	-96.6	-1.7	110.7	-17.2	-75.8	-11.3	77.7	20.6	76.6
	Min Fx	STR 1/ 28	-212.0	0.0	226.0	0.0	-49.1	0.0	49.1	0.0	49.1
	Min Fy	STR 3/ 1	-103.8	-3.5	114.7	-34.9	-55.2	-23.1	65.3	41.8	59.9
	Min Fz	STR 3/ 210	-13.9	-3.5	20.1	-35.3	-41.0	-23.7	54.1	42.5	47.4
	Min Mx	STR 3/ 10	-80.8	-3.5	91.2	-35.3	-56.8	-23.7	66.8	42.5	61.5
	Min My	STR 3/ 69	-96.6	-1.7	110.7	-17.2	-75.8	-11.3	77.7	20.6	76.6
	Min Mz	STR 3/ 10	-80.8	-3.5	91.2	-35.3	-56.8	-23.7	66.8	42.5	61.5
	Min Mxy	STR 3/ 165	-80.4	-1.7	85.0	-17.2	-17.9	-11.3	24.8	20.6	21.2
	Min Mxz	STR 1/ 1	-186.7	0.0	200.0	0.0	-49.8	0.0	49.8	0.0	49.8
	Min Myz	STR 3/ 165	-80.4	-1.7	85.0	-17.2	-17.9	-11.3	24.8	20.6	21.2
Load No. 10 **Member** 605 **Joint** 407	Max Fx	STR 3/ 210	-16.8	-2.4	25.6	-27.6	-21.9	-12.6	35.2	30.3	25.3
	Max Fy	STR 1/ 7	-141.7	0.2	183.5	1.4	-29.5	1.8	29.6	2.2	29.6
	Max Fz	STR 1/ 28	-209.2	0.0	267.7	0.0	-27.8	0.0	27.8	0.0	27.8
	Max Mx	STR 1/ 8	-127.7	0.2	166.0	1.6	-28.3	1.9	28.3	2.5	28.4
	Max My	STR 3/ 135	-49.7	-1.3	63.6	-13.3	-7.5	-5.7	15.3	14.5	9.4
	Max Mz	STR 1/ 8	-127.7	0.2	166.0	1.6	-28.3	1.9	28.3	2.5	28.4
	Max Mxy	STR 3/ 99	-133.7	-1.3	176.8	-13.3	-45.8	-5.7	47.7	14.5	46.1
	Max Mxz	STR 3/ 10	-88.3	-2.4	117.1	-27.6	-32.6	-12.6	42.7	30.3	35.0
	Max Myz	STR 3/ 99	-133.7	-1.3	176.8	-13.3	-45.8	-5.7	47.7	14.5	46.1
	Min Fx	STR 1/ 28	-209.2	0.0	267.7	0.0	-27.8	0.0	27.8	0.0	27.8
	Min Fy	STR 3/ 1	-108.1	-2.4	141.6	-26.7	-31.8	-11.5	41.5	29.1	33.8
	Min Fz	STR 3/ 210	-16.8	-2.4	25.6	-27.6	-21.9	-12.6	35.2	30.3	25.3
	Min Mx	STR 3/ 10	-88.3	-2.4	117.1	-27.6	-32.6	-12.6	42.7	30.3	35.0
	Min My	STR 3/ 99	-133.7	-1.3	176.8	-13.3	-45.8	-5.7	47.7	14.5	46.1
	Min Mz	STR 3/ 10	-88.3	-2.4	117.1	-27.6	-32.6	-12.6	42.7	30.3	35.0
	Min Mxy	STR 1/ 65	-89.6	0.0	115.9	0.0	-13.4	0.0	13.4	0.0	13.4
	Min Mxz	STR 1/ 1	-175.3	0.0	225.3	0.0	-27.3	0.0	27.3	0.0	27.3
	Min Myz	STR 3/ 135	-49.7	-1.3	63.6	-13.3	-7.5	-5.7	15.3	14.5	9.4

AASHTO Limit State: STR 1 - STRENGTH I

Max/ Min ID	Load Num	Member Num	Joint Num	Limit State/ Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
Max Fx	6	601	411	STR 1/ 213	341.1	0.0	-259.4	0.0	-135.8	0.0	135.8	0.0	135.8
Max Fy	5	505	407	STR 1/ 9	138.5	0.2	182.4	0.7	36.8	-0.9	36.8	1.1	36.8
Max Fz	5	505	407	STR 1/ 28	268.1	0.0	348.0	0.0	52.2	0.0	52.2	0.0	52.2
Max Mx	1	501	411	STR 1/ 8	-69.5	-0.2	-10.3	1.6	491.4	6.7	491.4	6.8	491.5
Max My	1	501	411	STR 1/ 47	-397.7	0.0	-159.3	0.0	504.2	0.0	504.2	0.0	504.2
Max Mz	1	501	411	STR 1/ 8	-69.5	-0.2	-10.3	1.6	491.4	6.7	491.4	6.8	491.5
Max Mxy	1	501	411	STR 1/ 47	-397.7	0.0	-159.3	0.0	504.2	0.0	504.2	0.0	504.2
Max Mxz	1	501	411	STR 1/ 8	-69.5	-0.2	-10.3	1.6	491.4	6.7	491.4	6.8	491.5
Max Myz	1	501	411	STR 1/ 47	-397.7	0.0	-159.3	0.0	504.2	0.0	504.2	0.0	504.2
Min Fx	1	501	411	STR 1/ 155	-398.8	0.0	-159.9	0.0	503.4	0.0	503.4	0.0	503.4
Min Fy	1	501	411	STR 1/ 7	-59.2	-0.2	-5.6	1.2	490.4	6.5	490.4	6.6	490.4
Min Fz	6	601	411	STR 1/ 213	341.1	0.0	-259.4	0.0	-135.8	0.0	135.8	0.0	135.8
Min Mx	5	505	407	STR 1/ 8	172.7	-0.2	226.4	-1.6	41.5	2.6	41.5	3.1	41.6
Min My	6	601	411	STR 1/ 156	332.5	0.0	-248.8	0.0	-189.1	0.0	189.1	0.0	189.1
Min Mz	6	601	411	STR 1/ 9	19.9	0.0	-2.0	-0.7	-181.3	-2.5	181.3	2.5	181.3
Min Mxy	10	605	407	STR 1/ 65	-89.6	0.0	115.9	0.0	-13.4	0.0	13.4	0.0	13.4
Min Mxz	1	501	411	STR 1/ 1	-54.6	0.0	-3.5	0.0	493.2	0.0	493.2	0.0	493.2
Min Myz	10	605	407	STR 1/ 65	-89.6	0.0	115.9	0.0	-13.4	0.0	13.4	0.0	13.4

AASHTO Limit State: STR 1 - STRENGTH I

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 1/ 57	-41.4	0.0	-3.4	0.0	350.7	0.0	350.7	0.0	350.7
	Max Fy	STR 1/ 1	-54.6	0.0	-3.5	0.0	493.2	0.0	493.2	0.0	493.2
	Max Fz	STR 1/ 3	-42.9	0.0	1.8	0.0	485.3	0.0	485.3	0.0	485.3
	Max Mx	STR 1/ 8	-69.5	-0.2	-10.3	1.6	491.4	6.7	491.4	6.8	491.5
	Max My	STR 1/ 47	-397.7	0.0	-159.3	0.0	504.2	0.0	504.2	0.0	504.2
Load No.	Max Mz	STR 1/ 8	-69.5	-0.2	-10.3	1.6	491.4	6.7	491.4	6.8	491.5
1	Max Mxy	STR 1/ 47	-397.7	0.0	-159.3	0.0	504.2	0.0	504.2	0.0	504.2
	Max Mxz	STR 1/ 8	-69.5	-0.2	-10.3	1.6	491.4	6.7	491.4	6.8	491.5
Member	Max Myz	STR 1/ 47	-397.7	0.0	-159.3	0.0	504.2	0.0	504.2	0.0	504.2
501	Min Fx	STR 1/ 155	-398.8	0.0	-159.9	0.0	503.4	0.0	503.4	0.0	503.4
	Min Fy	STR 1/ 7	-59.2	-0.2	-5.6	1.2	490.4	6.5	490.4	6.6	490.4
Joint	Min Fz	STR 1/ 209	-397.3	0.0	-165.1	0.0	368.9	0.0	368.9	0.0	368.9
411	Min Mx	STR 1/ 9	-53.2	0.0	-3.0	-0.4	486.5	-0.2	486.5	0.4	486.5
	Min My	STR 1/ 174	-120.7	0.0	-39.5	0.0	349.4	0.0	349.4	0.0	349.4
	Min Mz	STR 1/ 9	-53.2	0.0	-3.0	-0.4	486.5	-0.2	486.5	0.4	486.5
	Min Mxy	STR 1/ 174	-120.7	0.0	-39.5	0.0	349.4	0.0	349.4	0.0	349.4
	Min Mxz	STR 1/ 1	-54.6	0.0	-3.5	0.0	493.2	0.0	493.2	0.0	493.2
	Min Myz	STR 1/ 174	-120.7	0.0	-39.5	0.0	349.4	0.0	349.4	0.0	349.4
	Max Fx	STR 1/ 1	93.4	0.0	64.9	0.0	330.9	0.0	330.9	0.0	330.9
	Max Fy	STR 1/ 1	93.4	0.0	64.9	0.0	330.9	0.0	330.9	0.0	330.9
	Max Fz	STR 1/ 1	93.4	0.0	64.9	0.0	330.9	0.0	330.9	0.0	330.9
	Max Mx	STR 1/ 8	51.3	-0.2	43.5	0.9	328.5	6.7	328.5	6.7	328.5
	Max My	STR 1/ 47	-91.0	0.0	-28.1	0.0	345.0	0.0	345.0	0.0	345.0
Load No.	Max Mz	STR 1/ 8	51.3	-0.2	43.5	0.9	328.5	6.7	328.5	6.7	328.5
2	Max Mxy	STR 1/ 47	-91.0	0.0	-28.1	0.0	345.0	0.0	345.0	0.0	345.0
	Max Mxz	STR 1/ 8	51.3	-0.2	43.5	0.9	328.5	6.7	328.5	6.7	328.5
Member	Max Myz	STR 1/ 47	-91.0	0.0	-28.1	0.0	345.0	0.0	345.0	0.0	345.0
502	Min Fx	STR 1/ 213	-142.6	0.0	-59.2	0.0	244.7	0.0	244.7	0.0	244.7
	Min Fy	STR 1/ 7	61.6	-0.2	48.6	0.5	327.1	6.3	327.1	6.3	327.1
Joint	Min Fz	STR 1/ 213	-142.6	0.0	-59.2	0.0	244.7	0.0	244.7	0.0	244.7
410	Min Mx	STR 1/ 9	40.1	0.0	37.6	-0.4	321.6	-0.4	321.6	0.5	321.6
	Min My	STR 1/ 174	-15.4	0.0	4.7	0.0	230.5	0.0	230.5	0.0	230.5
	Min Mz	STR 1/ 9	40.1	0.0	37.6	-0.4	321.6	-0.4	321.6	0.5	321.6
	Min Mxy	STR 1/ 174	-15.4	0.0	4.7	0.0	230.5	0.0	230.5	0.0	230.5
	Min Mxz	STR 1/ 1	93.4	0.0	64.9	0.0	330.9	0.0	330.9	0.0	330.9
	Min Myz	STR 1/ 174	-15.4	0.0	4.7	0.0	230.5	0.0	230.5	0.0	230.5

AASHTO Limit State: STR 1 - STRENGTH I

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 1/ 1	176.9	0.0	118.2	0.0	200.7	0.0	200.7	0.0	200.7
	Max Fy	STR 1/ 1	176.9	0.0	118.2	0.0	200.7	0.0	200.7	0.0	200.7
	Max Fz	STR 1/ 1	176.9	0.0	118.2	0.0	200.7	0.0	200.7	0.0	200.7
	Max Mx	STR 1/ 1	176.9	0.0	118.2	0.0	200.7	0.0	200.7	0.0	200.7
	Max My	STR 1/ 47	85.2	0.0	64.4	0.0	214.9	0.0	214.9	0.0	214.9
Load No.	Max Mz	STR 1/ 8	120.4	-0.2	84.8	0.0	198.6	6.1	198.6	6.1	198.7
3	Max Mxy	STR 1/ 47	85.2	0.0	64.4	0.0	214.9	0.0	214.9	0.0	214.9
	Max Mxz	STR 1/ 8	120.4	-0.2	84.8	0.0	198.6	6.1	198.6	6.1	198.7
Member	Max Myz	STR 1/ 47	85.2	0.0	64.4	0.0	214.9	0.0	214.9	0.0	214.9
503	Min Fx	STR 1/ 213	0.8	0.0	10.6	0.0	151.4	0.0	151.4	0.0	151.4
	Min Fy	STR 1/ 7	131.3	-0.2	91.3	-0.4	197.0	5.6	197.0	5.6	197.1
Joint	Min Fz	STR 1/ 213	0.8	0.0	10.6	0.0	151.4	0.0	151.4	0.0	151.4
409	Min Mx	STR 1/ 7	131.3	-0.2	91.3	-0.4	197.0	5.6	197.0	5.6	197.1
	Min My	STR 1/ 174	50.5	0.0	39.5	0.0	136.6	0.0	136.6	0.0	136.6
	Min Mz	STR 1/ 9	96.4	0.0	70.6	-0.4	191.8	-0.5	191.8	0.6	191.8
	Min Mxy	STR 1/ 174	50.5	0.0	39.5	0.0	136.6	0.0	136.6	0.0	136.6
	Min Mxz	STR 1/ 1	176.9	0.0	118.2	0.0	200.7	0.0	200.7	0.0	200.7
	Min Myz	STR 1/ 174	50.5	0.0	39.5	0.0	136.6	0.0	136.6	0.0	136.6
	Max Fx	STR 1/ 28	251.3	0.0	201.6	0.0	116.8	0.0	116.8	0.0	116.8
	Max Fy	STR 1/ 1	221.2	0.0	178.4	0.0	105.4	0.0	105.4	0.0	105.4
	Max Fz	STR 1/ 28	251.3	0.0	201.6	0.0	116.8	0.0	116.8	0.0	116.8
	Max Mx	STR 1/ 1	221.2	0.0	178.4	0.0	105.4	0.0	105.4	0.0	105.4
	Max My	STR 1/ 29	230.7	0.0	186.0	0.0	119.8	0.0	119.8	0.0	119.8
Load No.	Max Mz	STR 1/ 8	160.5	-0.2	132.2	-1.2	103.6	5.8	103.6	5.9	103.8
4	Max Mxy	STR 1/ 29	230.7	0.0	186.0	0.0	119.8	0.0	119.8	0.0	119.8
	Max Mxz	STR 1/ 8	160.5	-0.2	132.2	-1.2	103.6	5.8	103.6	5.9	103.8
Member	Max Myz	STR 1/ 29	230.7	0.0	186.0	0.0	119.8	0.0	119.8	0.0	119.8
504	Min Fx	STR 1/ 186	55.2	0.0	49.2	0.0	72.1	0.0	72.1	0.0	72.1
	Min Fy	STR 1/ 7	170.8	-0.2	140.0	-1.1	102.1	4.9	102.1	5.0	102.2
Joint	Min Fz	STR 1/ 186	55.2	0.0	49.2	0.0	72.1	0.0	72.1	0.0	72.1
408	Min Mx	STR 1/ 8	160.5	-0.2	132.2	-1.2	103.6	5.8	103.6	5.9	103.8
	Min My	STR 1/ 174	84.0	0.0	70.9	0.0	68.2	0.0	68.2	0.0	68.2
	Min Mz	STR 1/ 9	130.8	0.0	109.4	0.0	97.2	-0.9	97.2	0.9	97.2
	Min Mxy	STR 1/ 174	84.0	0.0	70.9	0.0	68.2	0.0	68.2	0.0	68.2
	Min Mxz	STR 1/ 1	221.2	0.0	178.4	0.0	105.4	0.0	105.4	0.0	105.4
	Min Myz	STR 1/ 174	84.0	0.0	70.9	0.0	68.2	0.0	68.2	0.0	68.2

AASHTO Limit State: STR 1 - STRENGTH I

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 1/ 28	268.1	0.0	348.0	0.0	52.2	0.0	52.2	0.0	52.2
	Max Fy	STR 1/ 9	138.5	0.2	182.4	0.7	36.8	-0.9	36.8	1.1	36.8
	Max Fz	STR 1/ 28	268.1	0.0	348.0	0.0	52.2	0.0	52.2	0.0	52.2
	Max Mx	STR 1/ 9	138.5	0.2	182.4	0.7	36.8	-0.9	36.8	1.1	36.8
	Max My	STR 1/ 29	260.2	0.0	338.0	0.0	54.7	0.0	54.7	0.0	54.7
Load No.	Max Mz	STR 1/ 8	172.7	-0.2	226.4	-1.6	41.5	2.6	41.5	3.1	41.6
5	Max Mxy	STR 1/ 29	260.2	0.0	338.0	0.0	54.7	0.0	54.7	0.0	54.7
	Max Mxz	STR 1/ 8	172.7	-0.2	226.4	-1.6	41.5	2.6	41.5	3.1	41.6
Member	Max Myz	STR 1/ 29	260.2	0.0	338.0	0.0	54.7	0.0	54.7	0.0	54.7
505	Min Fx	STR 1/ 186	50.1	0.0	68.1	0.0	25.9	0.0	25.9	0.0	25.9
	Min Fy	STR 1/ 8	172.7	-0.2	226.4	-1.6	41.5	2.6	41.5	3.1	41.6
Joint	Min Fz	STR 1/ 186	50.1	0.0	68.1	0.0	25.9	0.0	25.9	0.0	25.9
407	Min Mx	STR 1/ 8	172.7	-0.2	226.4	-1.6	41.5	2.6	41.5	3.1	41.6
	Min My	STR 1/ 174	60.0	0.0	80.6	0.0	22.8	0.0	22.8	0.0	22.8
	Min Mz	STR 1/ 9	138.5	0.2	182.4	0.7	36.8	-0.9	36.8	1.1	36.8
	Min Mxy	STR 1/ 174	60.0	0.0	80.6	0.0	22.8	0.0	22.8	0.0	22.8
	Min Mxz	STR 1/ 1	218.9	0.0	285.0	0.0	42.5	0.0	42.5	0.0	42.5
	Min Myz	STR 1/ 174	60.0	0.0	80.6	0.0	22.8	0.0	22.8	0.0	22.8
	Max Fx	STR 1/ 213	341.1	0.0	-259.4	0.0	-135.8	0.0	135.8	0.0	135.8
	Max Fy	STR 1/ 1	-18.8	0.0	28.5	0.0	-173.1	0.0	173.1	0.0	173.1
	Max Fz	STR 1/ 1	-18.8	0.0	28.5	0.0	-173.1	0.0	173.1	0.0	173.1
	Max Mx	STR 1/ 1	-18.8	0.0	28.5	0.0	-173.1	0.0	173.1	0.0	173.1
	Max My	STR 1/ 56	-9.5	0.0	17.2	0.0	-119.3	0.0	119.3	0.0	119.3
Load No.	Max Mz	STR 1/ 8	4.3	0.0	10.1	-0.2	-173.6	1.6	173.6	1.6	173.6
6	Max Mxy	STR 1/ 156	332.5	0.0	-248.8	0.0	-189.1	0.0	189.1	0.0	189.1
	Max Mxz	STR 1/ 9	19.9	0.0	-2.0	-0.7	-181.3	-2.5	181.3	2.5	181.3
Member	Max Myz	STR 1/ 156	332.5	0.0	-248.8	0.0	-189.1	0.0	189.1	0.0	189.1
601	Min Fx	STR 1/ 1	-18.8	0.0	28.5	0.0	-173.1	0.0	173.1	0.0	173.1
	Min Fy	STR 1/ 1	-18.8	0.0	28.5	0.0	-173.1	0.0	173.1	0.0	173.1
Joint	Min Fz	STR 1/ 213	341.1	0.0	-259.4	0.0	-135.8	0.0	135.8	0.0	135.8
411	Min Mx	STR 1/ 7	1.9	0.0	12.2	-0.7	-175.9	-0.9	175.9	1.1	175.9
	Min My	STR 1/ 156	332.5	0.0	-248.8	0.0	-189.1	0.0	189.1	0.0	189.1
	Min Mz	STR 1/ 9	19.9	0.0	-2.0	-0.7	-181.3	-2.5	181.3	2.5	181.3
	Min Mxy	STR 1/ 56	-9.5	0.0	17.2	0.0	-119.3	0.0	119.3	0.0	119.3
	Min Mxz	STR 1/ 1	-18.8	0.0	28.5	0.0	-173.1	0.0	173.1	0.0	173.1
	Min Myz	STR 1/ 56	-9.5	0.0	17.2	0.0	-119.3	0.0	119.3	0.0	119.3

AASHTO Limit State: STR 1 - STRENGTH I

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 1/ 213	139.2	0.0	-108.1	0.0	-99.6	0.0	99.6	0.0	99.6
	Max Fy	STR 1/ 8	-56.4	0.2	59.3	0.2	-124.1	1.8	124.1	1.8	124.1
	Max Fz	STR 1/ 1	-96.0	0.0	92.3	0.0	-123.6	0.0	123.6	0.0	123.6
	Max Mx	STR 1/ 8	-56.4	0.2	59.3	0.2	-124.1	1.8	124.1	1.8	124.1
	Max My	STR 1/ 56	-73.0	0.0	69.6	0.0	-82.1	0.0	82.1	0.0	82.1
Load No.	Max Mz	STR 1/ 8	-56.4	0.2	59.3	0.2	-124.1	1.8	124.1	1.8	124.1
7	Max Mxy	STR 1/ 156	118.6	0.0	-87.2	0.0	-140.4	0.0	140.4	0.0	140.4
	Max Mxz	STR 1/ 9	-44.2	0.0	49.1	-0.7	-133.0	-1.8	133.0	1.9	133.0
Member	Max Myz	STR 1/ 156	118.6	0.0	-87.2	0.0	-140.4	0.0	140.4	0.0	140.4
602	Min Fx	STR 1/ 1	-96.0	0.0	92.3	0.0	-123.6	0.0	123.6	0.0	123.6
	Min Fy	STR 1/ 1	-96.0	0.0	92.3	0.0	-123.6	0.0	123.6	0.0	123.6
Joint	Min Fz	STR 1/ 213	139.2	0.0	-108.1	0.0	-99.6	0.0	99.6	0.0	99.6
410	Min Mx	STR 1/ 9	-44.2	0.0	49.1	-0.7	-133.0	-1.8	133.0	1.9	133.0
	Min My	STR 1/ 156	118.6	0.0	-87.2	0.0	-140.4	0.0	140.4	0.0	140.4
	Min Mz	STR 1/ 9	-44.2	0.0	49.1	-0.7	-133.0	-1.8	133.0	1.9	133.0
	Min Mxy	STR 1/ 56	-73.0	0.0	69.6	0.0	-82.1	0.0	82.1	0.0	82.1
	Min Mxz	STR 1/ 1	-96.0	0.0	92.3	0.0	-123.6	0.0	123.6	0.0	123.6
	Min Myz	STR 1/ 56	-73.0	0.0	69.6	0.0	-82.1	0.0	82.1	0.0	82.1
	Max Fx	STR 1/ 213	8.8	0.0	-0.6	0.0	-66.4	0.0	66.4	0.0	66.4
	Max Fy	STR 1/ 7	-112.3	0.2	112.4	0.0	-85.7	0.9	85.7	0.9	85.7
	Max Fz	STR 1/ 1	-149.8	0.0	146.3	0.0	-82.5	0.0	82.5	0.0	82.5
	Max Mx	STR 1/ 8	-99.7	0.2	100.7	0.5	-82.9	1.9	82.9	2.0	82.9
	Max My	STR 1/ 65	-78.6	0.0	78.4	0.0	-51.9	0.0	51.9	0.0	51.9
Load No.	Max Mz	STR 1/ 8	-99.7	0.2	100.7	0.5	-82.9	1.9	82.9	2.0	82.9
8	Max Mxy	STR 1/ 138	-79.0	0.0	82.5	0.0	-95.9	0.0	95.9	0.0	95.9
	Max Mxz	STR 1/ 8	-99.7	0.2	100.7	0.5	-82.9	1.9	82.9	2.0	82.9
Member	Max Myz	STR 1/ 138	-79.0	0.0	82.5	0.0	-95.9	0.0	95.9	0.0	95.9
603	Min Fx	STR 1/ 1	-149.8	0.0	146.3	0.0	-82.5	0.0	82.5	0.0	82.5
	Min Fy	STR 1/ 1	-149.8	0.0	146.3	0.0	-82.5	0.0	82.5	0.0	82.5
Joint	Min Fz	STR 1/ 213	8.8	0.0	-0.6	0.0	-66.4	0.0	66.4	0.0	66.4
409	Min Mx	STR 1/ 9	-87.7	0.0	90.0	-0.5	-91.6	-1.1	91.6	1.2	91.6
	Min My	STR 1/ 138	-79.0	0.0	82.5	0.0	-95.9	0.0	95.9	0.0	95.9
	Min Mz	STR 1/ 9	-87.7	0.0	90.0	-0.5	-91.6	-1.1	91.6	1.2	91.6
	Min Mxy	STR 1/ 65	-78.6	0.0	78.4	0.0	-51.9	0.0	51.9	0.0	51.9
	Min Mxz	STR 1/ 1	-149.8	0.0	146.3	0.0	-82.5	0.0	82.5	0.0	82.5
	Min Myz	STR 1/ 65	-78.6	0.0	78.4	0.0	-51.9	0.0	51.9	0.0	51.9

Sum-It: AASHTO LRFD Load Combination Generator
Figg Bridge Engineers, Inc.
Limit State Results
File Name: Pylon Anchor Forces_Member End Forces_Global.sum

AASHTO Limit State: STR 1 - STRENGTH I

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 1/ 186	-39.8	0.0	46.8	0.0	-40.0	0.0	40.0	0.0	40.0
	Max Fy	STR 1/ 7	-145.2	0.2	157.3	0.7	-52.6	1.9	52.6	2.0	52.6
	Max Fz	STR 1/ 28	-212.0	0.0	226.0	0.0	-49.1	0.0	49.1	0.0	49.1
	Max Mx	STR 1/ 8	-129.0	0.2	140.5	0.9	-50.3	2.1	50.3	2.3	50.4
	Max My	STR 1/ 92	-134.7	0.0	143.8	0.0	-27.8	0.0	27.8	0.0	27.8
Load No.	Max Mz	STR 1/ 8	-129.0	0.2	140.5	0.9	-50.3	2.1	50.3	2.3	50.4
9	Max Mxy	STR 1/ 111	-125.4	0.0	137.2	0.0	-60.5	0.0	60.5	0.0	60.5
	Max Mxz	STR 1/ 8	-129.0	0.2	140.5	0.9	-50.3	2.1	50.3	2.3	50.4
Member	Max Myz	STR 1/ 111	-125.4	0.0	137.2	0.0	-60.5	0.0	60.5	0.0	60.5
604	Min Fx	STR 1/ 28	-212.0	0.0	226.0	0.0	-49.1	0.0	49.1	0.0	49.1
	Min Fy	STR 1/ 1	-186.7	0.0	200.0	0.0	-49.8	0.0	49.8	0.0	49.8
Joint	Min Fz	STR 1/ 186	-39.8	0.0	46.8	0.0	-40.0	0.0	40.0	0.0	40.0
408	Min Mx	STR 1/ 9	-120.0	0.0	131.7	-0.2	-57.5	-0.4	57.5	0.4	57.5
	Min My	STR 1/ 111	-125.4	0.0	137.2	0.0	-60.5	0.0	60.5	0.0	60.5
	Min Mz	STR 1/ 9	-120.0	0.0	131.7	-0.2	-57.5	-0.4	57.5	0.4	57.5
	Min Mxy	STR 1/ 92	-134.7	0.0	143.8	0.0	-27.8	0.0	27.8	0.0	27.8
	Min Mxz	STR 1/ 1	-186.7	0.0	200.0	0.0	-49.8	0.0	49.8	0.0	49.8
	Min Myz	STR 1/ 92	-134.7	0.0	143.8	0.0	-27.8	0.0	27.8	0.0	27.8
	Max Fx	STR 1/ 186	-40.4	0.0	55.0	0.0	-22.0	0.0	22.0	0.0	22.0
	Max Fy	STR 1/ 7	-141.7	0.2	183.5	1.4	-29.5	1.8	29.6	2.2	29.6
	Max Fz	STR 1/ 28	-209.2	0.0	267.7	0.0	-27.8	0.0	27.8	0.0	27.8
	Max Mx	STR 1/ 8	-127.7	0.2	166.0	1.6	-28.3	1.9	28.3	2.5	28.4
	Max My	STR 1/ 65	-89.6	0.0	115.9	0.0	-13.4	0.0	13.4	0.0	13.4
Load No.	Max Mz	STR 1/ 8	-127.7	0.2	166.0	1.6	-28.3	1.9	28.3	2.5	28.4
10	Max Mxy	STR 1/ 138	-161.0	0.0	208.1	0.0	-35.3	0.0	35.3	0.0	35.3
	Max Mxz	STR 1/ 8	-127.7	0.2	166.0	1.6	-28.3	1.9	28.3	2.5	28.4
Member	Max Myz	STR 1/ 138	-161.0	0.0	208.1	0.0	-35.3	0.0	35.3	0.0	35.3
605	Min Fx	STR 1/ 28	-209.2	0.0	267.7	0.0	-27.8	0.0	27.8	0.0	27.8
	Min Fy	STR 1/ 1	-175.3	0.0	225.3	0.0	-27.3	0.0	27.3	0.0	27.3
Joint	Min Fz	STR 1/ 186	-40.4	0.0	55.0	0.0	-22.0	0.0	22.0	0.0	22.0
407	Min Mx	STR 1/ 9	-122.1	0.0	159.3	-0.2	-33.0	-0.2	33.0	0.2	33.0
	Min My	STR 1/ 138	-161.0	0.0	208.1	0.0	-35.3	0.0	35.3	0.0	35.3
	Min Mz	STR 1/ 9	-122.1	0.0	159.3	-0.2	-33.0	-0.2	33.0	0.2	33.0
	Min Mxy	STR 1/ 65	-89.6	0.0	115.9	0.0	-13.4	0.0	13.4	0.0	13.4
	Min Mxz	STR 1/ 1	-175.3	0.0	225.3	0.0	-27.3	0.0	27.3	0.0	27.3
	Min Myz	STR 1/ 65	-89.6	0.0	115.9	0.0	-13.4	0.0	13.4	0.0	13.4

Limit State: STRENGTH I

FR Friction
LF: 1
FR1: CR+SH+PT_EOC
FR2: CR+SH+PT_D10K

TU Uniform Temperature
LF: 0.5
TU1: TU-
TU2: TU+
TU3: TU+Temp. Diff.

DW DL Wearing Surfaces & Utilities
LF1: 1.5
LF2: 0.65
DW1: DW

LL Vehicular Live Load
LF: 1.75
LL1: LL1_Deck
LL2: LL2_Deck
LL3: LL3_Deck
LL4: LL1_Roof
LL5: LL2_Roof
LL6: LL3_Roof
LL7: LL1_Deck Offset
LL8: LL2_Deck Offset
LL9: LL3_Deck Offset

DC DL Structural Components & Attachments
LF1: 1.25
LF2: 0.9
DC1: DC

Combo ID	Load Combinations
STR 1/ 1	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU1*0.50 + LL1*1.75)
STR 1/ 2	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU1*0.50 + LL2*1.75)
STR 1/ 3	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU1*0.50 + LL3*1.75)
STR 1/ 4	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU1*0.50 + LL4*1.75)
STR 1/ 5	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU1*0.50 + LL5*1.75)
STR 1/ 6	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU1*0.50 + LL6*1.75)
STR 1/ 7	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU1*0.50 + LL7*1.75)
STR 1/ 8	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU1*0.50 + LL8*1.75)
STR 1/ 9	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU1*0.50 + LL9*1.75)
STR 1/ 10	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU2*0.50 + LL1*1.75)
STR 1/ 11	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU2*0.50 + LL2*1.75)
STR 1/ 12	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU2*0.50 + LL3*1.75)
STR 1/ 13	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU2*0.50 + LL4*1.75)
STR 1/ 14	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU2*0.50 + LL5*1.75)
STR 1/ 15	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU2*0.50 + LL6*1.75)
STR 1/ 16	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU2*0.50 + LL7*1.75)
STR 1/ 17	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU2*0.50 + LL8*1.75)
STR 1/ 18	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU2*0.50 + LL9*1.75)
STR 1/ 19	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU3*0.50 + LL1*1.75)
STR 1/ 20	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU3*0.50 + LL2*1.75)

Limit State: STRENGTH I

FR Friction
LF: 1
FR1: CR+SH+PT_EOC
FR2: CR+SH+PT_D10K

TU Uniform Temperature
LF: 0.5
TU1: TU-
TU2: TU+
TU3: TU+Temp. Diff.

DW DL Wearing Surfaces & Utilities
LF1: 1.5
LF2: 0.65
DW1: DW

LL Vehicular Live Load
LF: 1.75
LL1: LL1_Deck
LL2: LL2_Deck
LL3: LL3_Deck
LL4: LL1_Roof
LL5: LL2_Roof
LL6: LL3_Roof
LL7: LL1_Deck Offset
LL8: LL2_Deck Offset
LL9: LL3_Deck Offset

DC DL Structural Components & Attachments
LF1: 1.25
LF2: 0.9
DC1: DC

Load (Row) Number	User's Load ID	Member ID	Joint ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)
1	CR+SH+PT_D10K	501	411	-296.8	0	-134.7	0	14	0
2	CR+SH+PT_D10K	502	410	-97.2	0	-48.8	0	17	0
3	CR+SH+PT_D10K	503	409	16.4	0	10	0	17.6	0
4	CR+SH+PT_D10K	504	408	83.6	0	64.1	0	18.4	0
5	CR+SH+PT_D10K	505	407	110.9	0	141.7	0	15.8	0
6	CR+SH+PT_D10K	601	411	270.4	0	-213.4	0	-9	0
7	CR+SH+PT_D10K	602	410	101.1	0	-84.6	0	-7.1	0
8	CR+SH+PT_D10K	603	409	-10.1	0	9.4	0	-3.6	0
9	CR+SH+PT_D10K	604	408	-76.2	0	78.4	0	-0.8	0
10	CR+SH+PT_D10K	605	407	-90.3	0	113	0	-2.7	0
1	CR+SH+PT_EOC	501	411	-99.3	0	-45.1	0	5.3	0
2	CR+SH+PT_EOC	502	410	-20.6	0	-10.3	0	6.4	0
3	CR+SH+PT_EOC	503	409	25.7	0	15.3	0	6.7	0
4	CR+SH+PT_EOC	504	408	53.5	0	40.9	0	7	0
5	CR+SH+PT_EOC	505	407	61.7	0	78.7	0	6.1	0
6	CR+SH+PT_EOC	601	411	86.5	0	-68.2	0	-5.1	0
7	CR+SH+PT_EOC	602	410	23.7	0	-19.7	0	-4.4	0
8	CR+SH+PT_EOC	603	409	-21.4	0	19.6	0	-3	0
9	CR+SH+PT_EOC	604	408	-50.9	0	52.4	0	-1.5	0
10	CR+SH+PT_EOC	605	407	-56.4	0	70.6	0	-2.2	0

Load (Row) Number	User's Load ID	Member ID	Joint ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)
1	DC	501	411	-4.3	0	14.9	0	384.5	0
2	DC	502	410	6.3	0	17	0	251.7	0
3	DC	503	409	14.9	0	19.5	0	147.5	0
4	DC	504	408	19.9	0	22.9	0	71.5	0
5	DC	505	407	16.2	0	25.5	0	23.1	0
6	DC	601	411	-12	0	20.4	0	-140.1	0
7	DC	602	410	-13.6	0	20.8	0	-102	0
8	DC	603	409	-12.1	0	19	0	-69.6	0
9	DC	604	408	-10.2	0	16.9	0	-43.3	0
10	DC	605	407	-6.6	0	13.3	0	-23.2	0
1	DW	501	411	1.4	0	0.7	0	0.9	0
2	DW	502	410	10	0	5.1	0	1.2	0
3	DW	503	409	14.3	0	8.5	0	1.2	0
4	DW	504	408	15.8	0	12	0	1	0
5	DW	505	407	13.2	0	16.8	0	0.7	0
6	DW	601	411	-6.5	0	5.1	0	0.9	0
7	DW	602	410	-9.5	0	8	0	1.1	0
8	DW	603	409	-11.7	0	10.6	0	1	0
9	DW	604	408	-13	0	13.3	0	0.8	0
10	DW	605	407	-10.5	0	13.1	0	0.7	0
1	LL1_Deck	501	411	5.1	0	2.4	0	3.2	0
2	LL1_Deck	502	410	36.4	0	18.5	0	4.5	0
3	LL1_Deck	503	409	52.2	0	30.9	0	4.2	0
4	LL1_Deck	504	408	57.6	0	43.9	0	3.8	0
5	LL1_Deck	505	407	48.2	0	61.4	0	2.6	0
6	LL1_Deck	601	411	-23.6	0	18.6	0	3.3	0
7	LL1_Deck	602	410	-34.8	0	29.1	0	3.8	0
8	LL1_Deck	603	409	-42.8	0	38.9	0	3.6	0
9	LL1_Deck	604	408	-47.4	0	48.7	0	3.1	0
10	LL1_Deck	605	407	-38.4	0	47.8	0	2.6	0
1	LL1_Deck Offset	501	411	2.5	-0.1	1.2	0.7	1.6	3.7
2	LL1_Deck Offset	502	410	18.2	-0.1	9.2	0.3	2.3	3.6
3	LL1_Deck Offset	503	409	26.1	-0.1	15.5	-0.2	2.1	3.2
4	LL1_Deck Offset	504	408	28.8	-0.1	22	-0.6	1.9	2.8
5	LL1_Deck Offset	505	407	24.1	0	30.7	-0.5	1.3	1.1
6	LL1_Deck Offset	601	411	-11.8	0	9.3	-0.4	1.7	-0.5
7	LL1_Deck Offset	602	410	-17.4	0	14.5	-0.3	1.9	0
8	LL1_Deck Offset	603	409	-21.4	0.1	19.5	0	1.8	0.5
9	LL1_Deck Offset	604	408	-23.7	0.1	24.3	0.4	1.5	1.1
10	LL1_Deck Offset	605	407	-19.2	0.1	23.9	0.8	1.3	1
1	LL1_Roof	501	411	1.2	0	0.5	0	-0.8	0
2	LL1_Roof	502	410	4.1	0	2.1	0	0.8	0
3	LL1_Roof	503	409	5.9	0	3.5	0	0.5	0
4	LL1_Roof	504	408	6.9	0	5.3	0	0.5	0
5	LL1_Roof	505	407	6.2	0	7.9	0	0.3	0
6	LL1_Roof	601	411	-3.2	0	2.5	0	0.5	0
7	LL1_Roof	602	410	-4.2	0	3.6	0	0.5	0
8	LL1_Roof	603	409	-5.1	0	4.6	0	0.5	0
9	LL1_Roof	604	408	-5.2	0	5.4	0	0.4	0
10	LL1_Roof	605	407	-5.1	0	6.3	0	0	0
1	LL2_Deck	501	411	-6.7	0	-3	0	4.5	0
2	LL2_Deck	502	410	24.7	0	12.6	0	6.2	0
3	LL2_Deck	503	409	39.7	0	23.6	0	6	0
4	LL2_Deck	504	408	45.8	0	35	0	5.5	0
5	LL2_Deck	505	407	43.7	0	55.7	0	4	0
6	LL2_Deck	601	411	-20.7	0	16.2	0	6	0
7	LL2_Deck	602	410	-24.4	0	20.3	0	7.1	0
8	LL2_Deck	603	409	-28.3	0	25.6	0	6.8	0
9	LL2_Deck	604	408	-28.8	0	29.4	0	5.7	0
10	LL2_Deck	605	407	-22.4	0	27.7	0	4	0

Load (Row) Number	User's Load ID	Member ID	Joint ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)
1	LL2_Deck Offset	501	411	-3.4	-0.1	-1.5	0.9	2.2	3.8
2	LL2_Deck Offset	502	410	12.3	-0.1	6.3	0.5	3.1	3.8
3	LL2_Deck Offset	503	409	19.9	-0.1	11.8	0	3	3.5
4	LL2_Deck Offset	504	408	22.9	-0.1	17.5	-0.7	2.8	3.3
5	LL2_Deck Offset	505	407	21.8	-0.1	27.9	-0.9	2	1.5
6	LL2_Deck Offset	601	411	-10.4	0	8.1	-0.1	3	0.9
7	LL2_Deck Offset	602	410	-12.2	0.1	10.2	0.1	3.5	1
8	LL2_Deck Offset	603	409	-14.2	0.1	12.8	0.3	3.4	1.1
9	LL2_Deck Offset	604	408	-14.4	0.1	14.7	0.5	2.8	1.2
10	LL2_Deck Offset	605	407	-11.2	0.1	13.9	0.9	2	1.1
1	LL2_Roof	501	411	-0.2	0	-0.1	0	-0.7	0
2	LL2_Roof	502	410	2.8	0	1.4	0	1	0
3	LL2_Roof	503	409	4.5	0	2.6	0	0.7	0
4	LL2_Roof	504	408	5.5	0	4.2	0	0.7	0
5	LL2_Roof	505	407	5.5	0	7	0	0.5	0
6	LL2_Roof	601	411	-2.7	0	2.1	0	0.7	0
7	LL2_Roof	602	410	-3	0	2.5	0	0.8	0
8	LL2_Roof	603	409	-3.4	0	3.1	0	0.8	0
9	LL2_Roof	604	408	-3.5	0	3.6	0	0.7	0
10	LL2_Roof	605	407	-2.8	0	3.5	0	0.5	0
1	LL3_Deck	501	411	11.8	0	5.4	0	-1.3	0
2	LL3_Deck	502	410	11.7	0	5.9	0	-1.7	0
3	LL3_Deck	503	409	12.5	0	7.3	0	-1.8	0
4	LL3_Deck	504	408	11.8	0	8.9	0	-1.7	0
5	LL3_Deck	505	407	4.5	0	5.6	0	-1.5	0
6	LL3_Deck	601	411	-3	0	2.4	0	-2.7	0
7	LL3_Deck	602	410	-10.3	0	8.8	0	-3.3	0
8	LL3_Deck	603	409	-14.5	0	13.4	0	-3.2	0
9	LL3_Deck	604	408	-18.7	0	19.3	0	-2.6	0
10	LL3_Deck	605	407	-16	0	20.1	0	-1.4	0
1	LL3_Deck Offset	501	411	5.9	0	2.7	-0.2	-0.6	-0.1
2	LL3_Deck Offset	502	410	5.9	0	2.9	-0.2	-0.8	-0.2
3	LL3_Deck Offset	503	409	6.2	0	3.7	-0.2	-0.9	-0.3
4	LL3_Deck Offset	504	408	5.9	0	4.5	0	-0.9	-0.5
5	LL3_Deck Offset	505	407	2.3	0.1	2.8	0.4	-0.7	-0.5
6	LL3_Deck Offset	601	411	-1.5	0	1.2	-0.4	-1.4	-1.4
7	LL3_Deck Offset	602	410	-5.2	0	4.4	-0.4	-1.6	-1
8	LL3_Deck Offset	603	409	-7.3	0	6.7	-0.3	-1.6	-0.6
9	LL3_Deck Offset	604	408	-9.3	0	9.7	-0.1	-1.3	-0.2
10	LL3_Deck Offset	605	407	-8	0	10.1	-0.1	-0.7	-0.1
1	LL3_Roof	501	411	1.4	0	0.6	0	-0.1	0
2	LL3_Roof	502	410	1.3	0	0.7	0	-0.2	0
3	LL3_Roof	503	409	1.4	0	0.9	0	-0.2	0
4	LL3_Roof	504	408	1.4	0	1.1	0	-0.2	0
5	LL3_Roof	505	407	0.7	0	0.8	0	-0.2	0
6	LL3_Roof	601	411	-0.5	0	0.4	0	-0.3	0
7	LL3_Roof	602	410	-1.2	0	1	0	-0.4	0
8	LL3_Roof	603	409	-1.6	0	1.5	0	-0.4	0
9	LL3_Roof	604	408	-1.7	0	1.8	0	-0.3	0
10	LL3_Roof	605	407	-2.2	0	2.8	0	-0.5	0
1	TU-	501	411	78.1	0	35.5	0	0.6	0
2	TU-	502	410	54.9	0	27.8	0	0.4	0
3	TU-	503	409	39.6	0	23.4	0	0.9	0
4	TU-	504	408	36.7	0	28	0	1.7	0
5	TU-	505	407	65.5	0	83.5	0	3.9	0
6	TU-	601	411	-78.5	0	62	0	0.1	0
7	TU-	602	410	-55	0	46.2	0	0.1	0
8	TU-	603	409	-41.6	0	38	0	-0.6	0
9	TU-	604	408	-41.2	0	42.5	0	-1.6	0
10	TU-	605	407	-55.3	0	69.5	0	-3.3	0

Load (Row) Number	User's Load ID	Member ID	Joint ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)
1	TU+	501	411	-78.1	0	-35.5	0	-0.6	0
2	TU+	502	410	-54.9	0	-27.8	0	-0.4	0
3	TU+	503	409	-39.6	0	-23.4	0	-0.9	0
4	TU+	504	408	-36.7	0	-28	0	-1.7	0
5	TU+	505	407	-65.5	0	-83.5	0	-3.9	0
6	TU+	601	411	78.5	0	-62	0	-0.1	0
7	TU+	602	410	55	0	-46.2	0	-0.1	0
8	TU+	603	409	41.6	0	-38	0	0.6	0
9	TU+	604	408	41.2	0	-42.5	0	1.6	0
10	TU+	605	407	55.3	0	-69.5	0	3.3	0
1	TU+Temp. Diff.	501	411	-171.7	0	-78	0	0.7	0
2	TU+Temp. Diff.	502	410	-119.7	0	-60.5	0	1.5	0
3	TU+Temp. Diff.	503	409	-81.5	0	-48.1	0	1.2	0
4	TU+Temp. Diff.	504	408	-57.8	0	-44	0	0.8	0
5	TU+Temp. Diff.	505	407	-72	0	-91.8	0	-2.1	0
6	TU+Temp. Diff.	601	411	173.2	0	-136.8	0	-1.6	0
7	TU+Temp. Diff.	602	410	117.3	0	-98.4	0	-1.4	0
8	TU+Temp. Diff.	603	409	80.3	0	-73.3	0	-0.3	0
9	TU+Temp. Diff.	604	408	63.4	0	-65.3	0	0.9	0
10	TU+Temp. Diff.	605	407	65.3	0	-82	0	3.1	0

Sum-It: AASHTO LRFD Load Combination Generator
Figg Bridge Engineers, Inc.
Limit State Summary
File Name: Pylon Anchor Forces_Member End Forces_Global.sum

AASHTO Limit State: STR 3 - STRENGTH III

Max/ Min ID	Load Num	Member Num	Joint Num	Limit State/ Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
Max Fx	6	601	411	STR 3/ 240	354.2	-6.4	-269.8	-72.7	-137.0	-83.9	155.1	111.0	160.6
Max Fy	5	505	407	STR 3/ 5	127.6	-1.3	172.1	-11.5	51.6	3.6	52.8	12.0	51.7
Max Fz	5	505	407	STR 3/ 39	190.6	-1.3	246.0	-11.5	34.1	3.6	36.0	12.0	34.3
Max Mx	5	505	407	STR 3/ 5	127.6	-1.3	172.1	-11.5	51.6	3.6	52.8	12.0	51.7
Max My	1	501	411	STR 3/ 55	-387.9	-5.0	-150.9	-52.1	586.1	113.8	588.4	125.2	597.0
Max Mz	1	501	411	STR 3/ 10	-66.9	-10.4	-9.2	-103.7	487.7	237.4	498.6	259.1	542.4
Max Mxy	1	501	411	STR 3/ 55	-387.9	-5.0	-150.9	-52.1	586.1	113.8	588.4	125.2	597.0
Max Mxz	1	501	411	STR 3/ 10	-66.9	-10.4	-9.2	-103.7	487.7	237.4	498.6	259.1	542.4
Max Myz	1	501	411	STR 3/ 55	-387.9	-5.0	-150.9	-52.1	586.1	113.8	588.4	125.2	597.0
Min Fx	1	501	411	STR 3/ 120	-390.5	-10.4	-156.2	-103.7	495.7	237.4	506.4	259.1	549.6
Min Fy	1	501	411	STR 3/ 10	-66.9	-10.4	-9.2	-103.7	487.7	237.4	498.6	259.1	542.4
Min Fz	6	601	411	STR 3/ 240	354.2	-6.4	-269.8	-72.7	-137.0	-83.9	155.1	111.0	160.6
Min Mx	1	501	411	STR 3/ 1	-63.5	-10.2	-7.7	-105.0	487.6	231.8	498.8	254.5	539.9
Min My	6	601	411	STR 3/ 119	341.8	-3.2	-251.7	-35.4	-238.0	-40.6	240.6	53.9	241.4
Min Mz	6	601	411	STR 3/ 10	34.7	-6.4	-13.7	-72.7	-180.5	-83.9	194.6	111.0	199.0
Min Mxy	10	605	407	STR 3/ 135	-49.7	-1.3	63.6	-13.3	-7.5	-5.7	15.3	14.5	9.4
Min Mxz	5	505	407	STR 3/ 5	127.6	-1.3	172.1	-11.5	51.6	3.6	52.8	12.0	51.7
Min Myz	10	605	407	STR 3/ 135	-49.7	-1.3	63.6	-13.3	-7.5	-5.7	15.3	14.5	9.4

AASHTO Limit State: STR 3 - STRENGTH III

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 3/ 129	-60.2	-5.0	-16.1	-52.1	263.3	113.8	268.4	125.2	286.8
	Max Fy	STR 3/ 5	-65.5	-5.0	-4.6	-52.1	577.3	113.8	579.7	125.2	588.4
	Max Fz	STR 3/ 5	-65.5	-5.0	-4.6	-52.1	577.3	113.8	579.7	125.2	588.4
	Max Mx	STR 3/ 5	-65.5	-5.0	-4.6	-52.1	577.3	113.8	579.7	125.2	588.4
	Max My	STR 3/ 55	-387.9	-5.0	-150.9	-52.1	586.1	113.8	588.4	125.2	597.0
Load No.	Max Mz	STR 3/ 10	-66.9	-10.4	-9.2	-103.7	487.7	237.4	498.6	259.1	542.4
1	Max Mxy	STR 3/ 55	-387.9	-5.0	-150.9	-52.1	586.1	113.8	588.4	125.2	597.0
	Max Mxz	STR 3/ 10	-66.9	-10.4	-9.2	-103.7	487.7	237.4	498.6	259.1	542.4
Member	Max Myz	STR 3/ 55	-387.9	-5.0	-150.9	-52.1	586.1	113.8	588.4	125.2	597.0
501	Min Fx	STR 3/ 120	-390.5	-10.4	-156.2	-103.7	495.7	237.4	506.4	259.1	549.6
	Min Fy	STR 3/ 10	-66.9	-10.4	-9.2	-103.7	487.7	237.4	498.6	259.1	542.4
Joint	Min Fz	STR 3/ 239	-383.8	-5.0	-163.1	-52.1	271.2	113.8	276.2	125.2	294.2
411	Min Mx	STR 3/ 1	-63.5	-10.2	-7.7	-105.0	487.6	231.8	498.8	254.5	539.9
	Min My	STR 3/ 199	-139.5	-5.0	-52.2	-52.1	261.9	113.8	267.0	125.2	285.6
	Min Mz	STR 3/ 5	-65.5	-5.0	-4.6	-52.1	577.3	113.8	579.7	125.2	588.4
	Min Mxy	STR 3/ 199	-139.5	-5.0	-52.2	-52.1	261.9	113.8	267.0	125.2	285.6
	Min Mxz	STR 3/ 5	-65.5	-5.0	-4.6	-52.1	577.3	113.8	579.7	125.2	588.4
	Min Myz	STR 3/ 199	-139.5	-5.0	-52.2	-52.1	261.9	113.8	267.0	125.2	285.6
	Max Fx	STR 3/ 5	31.1	-4.1	36.8	-38.4	387.4	73.9	389.3	83.3	394.4
	Max Fy	STR 3/ 5	31.1	-4.1	36.8	-38.4	387.4	73.9	389.3	83.3	394.4
	Max Fz	STR 3/ 5	31.1	-4.1	36.8	-38.4	387.4	73.9	389.3	83.3	394.4
	Max Mx	STR 3/ 5	31.1	-4.1	36.8	-38.4	387.4	73.9	389.3	83.3	394.4
	Max My	STR 3/ 55	-132.8	-4.1	-45.8	-38.4	398.6	73.9	400.4	83.3	405.4
Load No.	Max Mz	STR 3/ 10	11.9	-8.4	23.5	-76.7	320.4	156.9	329.4	174.7	356.7
2	Max Mxy	STR 3/ 55	-132.8	-4.1	-45.8	-38.4	398.6	73.9	400.4	83.3	405.4
	Max Mxz	STR 3/ 10	11.9	-8.4	23.5	-76.7	320.4	156.9	329.4	174.7	356.7
Member	Max Myz	STR 3/ 55	-132.8	-4.1	-45.8	-38.4	398.6	73.9	400.4	83.3	405.4
502	Min Fx	STR 3/ 240	-162.7	-8.4	-69.4	-76.7	242.4	156.9	254.3	174.7	288.8
	Min Fy	STR 3/ 1	29.7	-8.4	32.5	-77.4	323.0	151.5	332.2	170.1	356.8
Joint	Min Fz	STR 3/ 240	-162.7	-8.4	-69.4	-76.7	242.4	156.9	254.3	174.7	288.8
410	Min Mx	STR 3/ 1	29.7	-8.4	32.5	-77.4	323.0	151.5	332.2	170.1	356.8
	Min My	STR 3/ 199	-37.4	-4.1	-9.9	-38.4	169.1	73.9	173.4	83.3	184.6
	Min Mz	STR 3/ 5	31.1	-4.1	36.8	-38.4	387.4	73.9	389.3	83.3	394.4
	Min Mxy	STR 3/ 199	-37.4	-4.1	-9.9	-38.4	169.1	73.9	173.4	83.3	184.6
	Min Mxz	STR 3/ 5	31.1	-4.1	36.8	-38.4	387.4	73.9	389.3	83.3	394.4
	Min Myz	STR 3/ 199	-37.4	-4.1	-9.9	-38.4	169.1	73.9	173.4	83.3	184.6

AASHTO Limit State: STR 3 - STRENGTH III

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 3/ 5	88.8	-3.2	69.3	-27.0	236.7	42.3	238.3	50.2	240.5
	Max Fy	STR 3/ 5	88.8	-3.2	69.3	-27.0	236.7	42.3	238.3	50.2	240.5
	Max Fz	STR 3/ 5	88.8	-3.2	69.3	-27.0	236.7	42.3	238.3	50.2	240.5
	Max Mx	STR 3/ 5	88.8	-3.2	69.3	-27.0	236.7	42.3	238.3	50.2	240.5
	Max My	STR 3/ 55	18.9	-3.2	28.3	-27.0	247.8	42.3	249.2	50.2	251.4
Load No.	Max Mz	STR 3/ 10	60.2	-6.6	49.1	-54.7	191.2	92.7	198.9	107.6	212.5
3	Max Mxy	STR 3/ 55	18.9	-3.2	28.3	-27.0	247.8	42.3	249.2	50.2	251.4
	Max Mxz	STR 3/ 10	60.2	-6.6	49.1	-54.7	191.2	92.7	198.9	107.6	212.5
Member	Max Myz	STR 3/ 55	18.9	-3.2	28.3	-27.0	247.8	42.3	249.2	50.2	251.4
503	Min Fx	STR 3/ 240	-27.0	-6.6	-6.0	-54.7	149.6	92.7	159.3	107.6	176.0
	Min Fy	STR 3/ 10	60.2	-6.6	49.1	-54.7	191.2	92.7	198.9	107.6	212.5
Joint	Min Fz	STR 3/ 240	-27.0	-6.6	-6.0	-54.7	149.6	92.7	159.3	107.6	176.0
409	Min Mx	STR 3/ 1	85.6	-6.4	64.1	-54.7	193.3	87.2	200.9	103.0	212.1
	Min My	STR 3/ 199	25.4	-3.2	21.5	-27.0	96.4	42.3	100.1	50.2	105.2
	Min Mz	STR 3/ 5	88.8	-3.2	69.3	-27.0	236.7	42.3	238.3	50.2	240.5
	Min Mxy	STR 3/ 199	25.4	-3.2	21.5	-27.0	96.4	42.3	100.1	50.2	105.2
	Min Mxz	STR 3/ 5	88.8	-3.2	69.3	-27.0	236.7	42.3	238.3	50.2	240.5
	Min Myz	STR 3/ 199	25.4	-3.2	21.5	-27.0	96.4	42.3	100.1	50.2	105.2
	Max Fx	STR 3/ 35	151.9	-2.2	128.8	-18.1	136.3	18.8	137.5	26.0	137.6
	Max Fy	STR 3/ 5	121.8	-2.2	105.6	-18.1	124.9	18.8	126.2	26.0	126.3
	Max Fz	STR 3/ 35	151.9	-2.2	128.8	-18.1	136.3	18.8	137.5	26.0	137.6
	Max Mx	STR 3/ 5	121.8	-2.2	105.6	-18.1	124.9	18.8	126.2	26.0	126.3
	Max My	STR 3/ 35	151.9	-2.2	128.8	-18.1	136.3	18.8	137.5	26.0	137.6
Load No.	Max Mz	STR 3/ 10	91.7	-4.8	79.7	-37.9	96.8	45.4	103.9	59.1	106.9
4	Max Mxy	STR 3/ 35	151.9	-2.2	128.8	-18.1	136.3	18.8	137.5	26.0	137.6
	Max Mxz	STR 3/ 10	91.7	-4.8	79.7	-37.9	96.8	45.4	103.9	59.1	106.9
Member	Max Myz	STR 3/ 35	151.9	-2.2	128.8	-18.1	136.3	18.8	137.5	26.0	137.6
504	Min Fx	STR 3/ 210	24.1	-4.8	25.5	-37.9	70.4	45.4	80.0	59.1	83.8
	Min Fy	STR 3/ 10	91.7	-4.8	79.7	-37.9	96.8	45.4	103.9	59.1	106.9
Joint	Min Fz	STR 3/ 210	24.1	-4.8	25.5	-37.9	70.4	45.4	80.0	59.1	83.8
408	Min Mx	STR 3/ 10	91.7	-4.8	79.7	-37.9	96.8	45.4	103.9	59.1	106.9
	Min My	STR 3/ 199	61.9	-2.2	51.3	-18.1	45.0	18.8	48.5	26.0	48.7
	Min Mz	STR 3/ 5	121.8	-2.2	105.6	-18.1	124.9	18.8	126.2	26.0	126.3
	Min Mxy	STR 3/ 199	61.9	-2.2	51.3	-18.1	45.0	18.8	48.5	26.0	48.7
	Min Mxz	STR 3/ 5	121.8	-2.2	105.6	-18.1	124.9	18.8	126.2	26.0	126.3
	Min Myz	STR 3/ 199	61.9	-2.2	51.3	-18.1	45.0	18.8	48.5	26.0	48.7

AASHTO Limit State: STR 3 - STRENGTH III

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 3/ 39	190.6	-1.3	246.0	-11.5	34.1	3.6	36.0	12.0	34.3
	Max Fy	STR 3/ 5	127.6	-1.3	172.1	-11.5	51.6	3.6	52.8	12.0	51.7
	Max Fz	STR 3/ 39	190.6	-1.3	246.0	-11.5	34.1	3.6	36.0	12.0	34.3
	Max Mx	STR 3/ 5	127.6	-1.3	172.1	-11.5	51.6	3.6	52.8	12.0	51.7
	Max My	STR 3/ 35	176.8	-1.3	235.1	-11.5	61.3	3.6	62.3	12.0	61.4
Load No.	Max Mz	STR 3/ 10	110.0	-2.9	146.3	-26.6	36.7	12.6	45.3	29.4	38.8
5	Max Mxy	STR 3/ 35	176.8	-1.3	235.1	-11.5	61.3	3.6	62.3	12.0	61.4
	Max Mxz	STR 3/ 10	110.0	-2.9	146.3	-26.6	36.7	12.6	45.3	29.4	38.8
Member	Max Myz	STR 3/ 35	176.8	-1.3	235.1	-11.5	61.3	3.6	62.3	12.0	61.4
505	Min Fx	STR 3/ 210	24.4	-2.9	35.5	-26.6	25.0	12.6	36.5	29.4	28.0
	Min Fy	STR 3/ 10	110.0	-2.9	146.3	-26.6	36.7	12.6	45.3	29.4	38.8
Joint	Min Fz	STR 3/ 210	24.4	-2.9	35.5	-26.6	25.0	12.6	36.5	29.4	28.0
407	Min Mx	STR 3/ 10	110.0	-2.9	146.3	-26.6	36.7	12.6	45.3	29.4	38.8
	Min My	STR 3/ 199	59.0	-1.3	76.3	-11.5	11.8	3.6	16.5	12.0	12.4
	Min Mz	STR 3/ 5	127.6	-1.3	172.1	-11.5	51.6	3.6	52.8	12.0	51.7
	Min Mxy	STR 3/ 199	59.0	-1.3	76.3	-11.5	11.8	3.6	16.5	12.0	12.4
	Min Mxz	STR 3/ 5	127.6	-1.3	172.1	-11.5	51.6	3.6	52.8	12.0	51.7
	Min Myz	STR 3/ 199	59.0	-1.3	76.3	-11.5	11.8	3.6	16.5	12.0	12.4
	Max Fx	STR 3/ 240	354.2	-6.4	-269.8	-72.7	-137.0	-83.9	155.1	111.0	160.6
	Max Fy	STR 3/ 5	18.4	-3.2	-5.3	-35.4	-125.2	-40.6	130.1	53.9	131.6
	Max Fz	STR 3/ 9	26.6	-3.2	-2.8	-35.4	-232.4	-40.6	235.1	53.9	236.0
	Max Mx	STR 3/ 5	18.4	-3.2	-5.3	-35.4	-125.2	-40.6	130.1	53.9	131.6
	Max My	STR 3/ 125	22.6	-3.2	-12.5	-35.4	-76.2	-40.6	84.0	53.9	86.3
Load No.	Max Mz	STR 3/ 5	18.4	-3.2	-5.3	-35.4	-125.2	-40.6	130.1	53.9	131.6
6	Max Mxy	STR 3/ 119	341.8	-3.2	-251.7	-35.4	-238.0	-40.6	240.6	53.9	241.4
	Max Mxz	STR 3/ 10	34.7	-6.4	-13.7	-72.7	-180.5	-83.9	194.6	111.0	199.0
Member	Max Myz	STR 3/ 119	341.8	-3.2	-251.7	-35.4	-238.0	-40.6	240.6	53.9	241.4
601	Min Fx	STR 3/ 5	18.4	-3.2	-5.3	-35.4	-125.2	-40.6	130.1	53.9	131.6
	Min Fy	STR 3/ 1	22.5	-6.4	-4.1	-71.8	-178.8	-82.3	192.7	109.2	196.9
Joint	Min Fz	STR 3/ 240	354.2	-6.4	-269.8	-72.7	-137.0	-83.9	155.1	111.0	160.6
411	Min Mx	STR 3/ 10	34.7	-6.4	-13.7	-72.7	-180.5	-83.9	194.6	111.0	199.0
	Min My	STR 3/ 119	341.8	-3.2	-251.7	-35.4	-238.0	-40.6	240.6	53.9	241.4
	Min Mz	STR 3/ 10	34.7	-6.4	-13.7	-72.7	-180.5	-83.9	194.6	111.0	199.0
	Min Mxy	STR 3/ 125	22.6	-3.2	-12.5	-35.4	-76.2	-40.6	84.0	53.9	86.3
	Min Mxz	STR 3/ 5	18.4	-3.2	-5.3	-35.4	-125.2	-40.6	130.1	53.9	131.6
	Min Myz	STR 3/ 125	22.6	-3.2	-12.5	-35.4	-76.2	-40.6	84.0	53.9	86.3

Sum-It: AASHTO LRFD Load Combination Generator
Figg Bridge Engineers, Inc.
Limit State Results
File Name: Pylon Anchor Forces_Member End Forces_Global.sum

AASHTO Limit State: STR 3 - STRENGTH III

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
Load No. 7 **Member** 602 **Joint** 410	Max Fx	STR 3/ 240	158.7	-5.5	-124.4	-58.2	-100.8	-60.3	116.5	83.9	117.5
	Max Fy	STR 3/ 5	-33.2	-2.7	35.9	-28.4	-89.9	-29.1	94.3	40.7	94.5
	Max Fz	STR 3/ 9	-36.7	-2.7	46.9	-28.4	-170.5	-29.1	172.9	40.7	173.0
	Max Mx	STR 3/ 5	-33.2	-2.7	35.9	-28.4	-89.9	-29.1	94.3	40.7	94.5
	Max My	STR 3/ 125	-28.5	-2.7	28.7	-28.4	-54.2	-29.1	61.2	40.7	61.5
	Max Mz	STR 3/ 5	-33.2	-2.7	35.9	-28.4	-89.9	-29.1	94.3	40.7	94.5
	Max Mxy	STR 3/ 119	134.9	-2.7	-97.1	-28.4	-174.9	-29.1	177.2	40.7	177.3
	Max Mxz	STR 3/ 10	-17.7	-5.5	26.8	-58.2	-132.2	-60.3	144.4	83.9	145.3
	Max Myz	STR 3/ 119	134.9	-2.7	-97.1	-28.4	-174.9	-29.1	177.2	40.7	177.3
	Min Fx	STR 3/ 9	-36.7	-2.7	46.9	-28.4	-170.5	-29.1	172.9	40.7	173.0
	Min Fy	STR 3/ 1	-35.1	-5.5	41.4	-57.5	-130.2	-59.1	142.3	82.5	143.0
	Min Fz	STR 3/ 240	158.7	-5.5	-124.4	-58.2	-100.8	-60.3	116.5	83.9	117.5
	Min Mx	STR 3/ 10	-17.7	-5.5	26.8	-58.2	-132.2	-60.3	144.4	83.9	145.3
	Min My	STR 3/ 119	134.9	-2.7	-97.1	-28.4	-174.9	-29.1	177.2	40.7	177.3
	Min Mz	STR 3/ 10	-17.7	-5.5	26.8	-58.2	-132.2	-60.3	144.4	83.9	145.3
	Min Mxy	STR 3/ 125	-28.5	-2.7	28.7	-28.4	-54.2	-29.1	61.2	40.7	61.5
	Min Mxz	STR 3/ 5	-33.2	-2.7	35.9	-28.4	-89.9	-29.1	94.3	40.7	94.5
	Min Myz	STR 3/ 125	-28.5	-2.7	28.7	-28.4	-54.2	-29.1	61.2	40.7	61.5
Load No. 8 **Member** 603 **Joint** 409	Max Fx	STR 3/ 240	32.7	-4.5	-22.6	-45.8	-67.6	-40.0	81.6	60.8	78.5
	Max Fy	STR 3/ 5	-70.1	-2.2	70.3	-22.3	-59.7	-19.3	63.7	29.5	62.7
	Max Fz	STR 3/ 9	-79.6	-2.2	86.2	-22.3	-117.9	-19.3	120.0	29.5	119.5
	Max Mx	STR 3/ 5	-70.1	-2.2	70.3	-22.3	-59.7	-19.3	63.7	29.5	62.7
	Max My	STR 3/ 135	-24.3	-2.2	25.6	-22.3	-34.7	-19.3	41.2	29.5	39.7
	Max Mz	STR 3/ 5	-70.1	-2.2	70.3	-22.3	-59.7	-19.3	63.7	29.5	62.7
	Max Mxy	STR 3/ 99	-58.4	-2.2	67.0	-22.3	-119.4	-19.3	121.4	29.5	120.9
	Max Mxz	STR 3/ 10	-53.7	-4.5	58.9	-45.8	-90.6	-40.0	101.5	60.8	99.1
	Max Myz	STR 3/ 99	-58.4	-2.2	67.0	-22.3	-119.4	-19.3	121.4	29.5	120.9
	Min Fx	STR 3/ 9	-79.6	-2.2	86.2	-22.3	-117.9	-19.3	120.0	29.5	119.5
	Min Fy	STR 3/ 1	-74.9	-4.5	78.3	-45.2	-88.8	-39.2	99.7	59.8	97.1
	Min Fz	STR 3/ 240	32.7	-4.5	-22.6	-45.8	-67.6	-40.0	81.6	60.8	78.5
	Min Mx	STR 3/ 10	-53.7	-4.5	58.9	-45.8	-90.6	-40.0	101.5	60.8	99.1
	Min My	STR 3/ 99	-58.4	-2.2	67.0	-22.3	-119.4	-19.3	121.4	29.5	120.9
	Min Mz	STR 3/ 10	-53.7	-4.5	58.9	-45.8	-90.6	-40.0	101.5	60.8	99.1
	Min Mxy	STR 3/ 135	-24.3	-2.2	25.6	-22.3	-34.7	-19.3	41.2	29.5	39.7
	Min Mxz	STR 3/ 5	-70.1	-2.2	70.3	-22.3	-59.7	-19.3	63.7	29.5	62.7
	Min Myz	STR 3/ 135	-24.3	-2.2	25.6	-22.3	-34.7	-19.3	41.2	29.5	39.7

AASHTO Limit State: STR 3 - STRENGTH III

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 3/ 210	-13.9	-3.5	20.1	-35.3	-41.0	-23.7	54.1	42.5	47.4
	Max Fy	STR 3/ 5	-99.8	-1.7	107.4	-17.2	-35.3	-11.3	39.3	20.6	37.1
	Max Fz	STR 3/ 39	-133.0	-1.7	148.0	-17.2	-74.4	-11.3	76.4	20.6	75.3
	Max Mx	STR 3/ 5	-99.8	-1.7	107.4	-17.2	-35.3	-11.3	39.3	20.6	37.1
	Max My	STR 3/ 165	-80.4	-1.7	85.0	-17.2	-17.9	-11.3	24.8	20.6	21.2
Load No.	Max Mz	STR 3/ 5	-99.8	-1.7	107.4	-17.2	-35.3	-11.3	39.3	20.6	37.1
9	Max Mxy	STR 3/ 69	-96.6	-1.7	110.7	-17.2	-75.8	-11.3	77.7	20.6	76.6
	Max Mxz	STR 3/ 10	-80.8	-3.5	91.2	-35.3	-56.8	-23.7	66.8	42.5	61.5
Member	Max Myz	STR 3/ 69	-96.6	-1.7	110.7	-17.2	-75.8	-11.3	77.7	20.6	76.6
604	Min Fx	STR 3/ 39	-133.0	-1.7	148.0	-17.2	-74.4	-11.3	76.4	20.6	75.3
	Min Fy	STR 3/ 1	-103.8	-3.5	114.7	-34.9	-55.2	-23.1	65.3	41.8	59.9
Joint	Min Fz	STR 3/ 210	-13.9	-3.5	20.1	-35.3	-41.0	-23.7	54.1	42.5	47.4
408	Min Mx	STR 3/ 10	-80.8	-3.5	91.2	-35.3	-56.8	-23.7	66.8	42.5	61.5
	Min My	STR 3/ 69	-96.6	-1.7	110.7	-17.2	-75.8	-11.3	77.7	20.6	76.6
	Min Mz	STR 3/ 10	-80.8	-3.5	91.2	-35.3	-56.8	-23.7	66.8	42.5	61.5
	Min Mxy	STR 3/ 165	-80.4	-1.7	85.0	-17.2	-17.9	-11.3	24.8	20.6	21.2
	Min Mxz	STR 3/ 5	-99.8	-1.7	107.4	-17.2	-35.3	-11.3	39.3	20.6	37.1
	Min Myz	STR 3/ 165	-80.4	-1.7	85.0	-17.2	-17.9	-11.3	24.8	20.6	21.2
	Max Fx	STR 3/ 210	-16.8	-2.4	25.6	-27.6	-21.9	-12.6	35.2	30.3	25.3
	Max Fy	STR 3/ 5	-107.4	-1.3	137.7	-13.3	-18.9	-5.7	23.1	14.5	19.8
	Max Fz	STR 3/ 39	-142.7	-1.3	187.9	-13.3	-45.2	-5.7	47.1	14.5	45.5
	Max Mx	STR 3/ 5	-107.4	-1.3	137.7	-13.3	-18.9	-5.7	23.1	14.5	19.8
	Max My	STR 3/ 135	-49.7	-1.3	63.6	-13.3	-7.5	-5.7	15.3	14.5	9.4
Load No.	Max Mz	STR 3/ 5	-107.4	-1.3	137.7	-13.3	-18.9	-5.7	23.1	14.5	19.8
10	Max Mxy	STR 3/ 99	-133.7	-1.3	176.8	-13.3	-45.8	-5.7	47.7	14.5	46.1
	Max Mxz	STR 3/ 10	-88.3	-2.4	117.1	-27.6	-32.6	-12.6	42.7	30.3	35.0
Member	Max Myz	STR 3/ 99	-133.7	-1.3	176.8	-13.3	-45.8	-5.7	47.7	14.5	46.1
605	Min Fx	STR 3/ 39	-142.7	-1.3	187.9	-13.3	-45.2	-5.7	47.1	14.5	45.5
	Min Fy	STR 3/ 1	-108.1	-2.4	141.6	-26.7	-31.8	-11.5	41.5	29.1	33.8
Joint	Min Fz	STR 3/ 210	-16.8	-2.4	25.6	-27.6	-21.9	-12.6	35.2	30.3	25.3
407	Min Mx	STR 3/ 10	-88.3	-2.4	117.1	-27.6	-32.6	-12.6	42.7	30.3	35.0
	Min My	STR 3/ 99	-133.7	-1.3	176.8	-13.3	-45.8	-5.7	47.7	14.5	46.1
	Min Mz	STR 3/ 10	-88.3	-2.4	117.1	-27.6	-32.6	-12.6	42.7	30.3	35.0
	Min Mxy	STR 3/ 135	-49.7	-1.3	63.6	-13.3	-7.5	-5.7	15.3	14.5	9.4
	Min Mxz	STR 3/ 5	-107.4	-1.3	137.7	-13.3	-18.9	-5.7	23.1	14.5	19.8
	Min Myz	STR 3/ 135	-49.7	-1.3	63.6	-13.3	-7.5	-5.7	15.3	14.5	9.4

Limit State: STRENGTH III

FR Friction
LF: 1
FR1: CR+SH+PT_EOC
FR2: CR+SH+PT_D10K

DC DL Structural Components & Attachments
LF1: 1.25
LF2: 0.9
DC1: DC

TU Uniform Temperature
LF: 0.5
TU1: TU-
TU2: TU+
TU3: TU+Temp. Diff.

WS Wind Load on Structure
LF: 1.4
WS1: WS_0 DEG
WS2: WS_15 DEG
WS3: WS_30 DEG
WS4: WS_45 DEG
WS5: WS_60 DEG
WS6: WS_-15 DEG
WS7: WS_-30 DEG
WS8: WS_-45 DEG
WS9: WS_-60 DEG
WS10: WS+WUP

DW DL Wearing Surfaces & Utilities
LF1: 1.5
LF2: 0.65
DW1: DW

Combo ID	Load Combinations
STR 3/ 1	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS1*1.40)
STR 3/ 2	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS2*1.40)
STR 3/ 3	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS3*1.40)
STR 3/ 4	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS4*1.40)
STR 3/ 5	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS5*1.40)
STR 3/ 6	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS6*1.40)
STR 3/ 7	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS7*1.40)
STR 3/ 8	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS8*1.40)
STR 3/ 9	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS9*1.40)
STR 3/ 10	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS10*1.40)
STR 3/ 11	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU2*0.50 + WS1*1.40)
STR 3/ 12	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU2*0.50 + WS2*1.40)
STR 3/ 13	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU2*0.50 + WS3*1.40)
STR 3/ 14	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU2*0.50 + WS4*1.40)
STR 3/ 15	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU2*0.50 + WS5*1.40)
STR 3/ 16	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU2*0.50 + WS6*1.40)
STR 3/ 17	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU2*0.50 + WS7*1.40)
STR 3/ 18	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU2*0.50 + WS8*1.40)
STR 3/ 19	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU2*0.50 + WS9*1.40)

Limit State: STRENGTH III

FR Friction
LF: 1
FR1: CR+SH+PT_EOC
FR2: CR+SH+PT_D10K

DC DL Structural Components & Attachments
LF1: 1.25
LF2: 0.9
DC1: DC

TU Uniform Temperature
LF: 0.5
TU1: TU-
TU2: TU+
TU3: TU+Temp. Diff.

WS Wind Load on Structure
LF: 1.4
WS1: WS_0 DEG
WS2: WS_15 DEG
WS3: WS_30 DEG
WS4: WS_45 DEG
WS5: WS_60 DEG
WS6: WS_-15 DEG
WS7: WS_-30 DEG
WS8: WS_-45 DEG
WS9: WS_-60 DEG
WS10: WS+WUP

DW DL Wearing Surfaces & Utilities
LF1: 1.5
LF2: 0.65
DW1: DW

Load (Row) Number	User's Load ID	Member ID	Joint ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)
1	CR+SH+PT_D10K	501	411	-296.8	0	-134.7	0	14	0
2	CR+SH+PT_D10K	502	410	-97.2	0	-48.8	0	17	0
3	CR+SH+PT_D10K	503	409	16.4	0	10	0	17.6	0
4	CR+SH+PT_D10K	504	408	83.6	0	64.1	0	18.4	0
5	CR+SH+PT_D10K	505	407	110.9	0	141.7	0	15.8	0
6	CR+SH+PT_D10K	601	411	270.4	0	-213.4	0	-9	0
7	CR+SH+PT_D10K	602	410	101.1	0	-84.6	0	-7.1	0
8	CR+SH+PT_D10K	603	409	-10.1	0	9.4	0	-3.6	0
9	CR+SH+PT_D10K	604	408	-76.2	0	78.4	0	-0.8	0
10	CR+SH+PT_D10K	605	407	-90.3	0	113	0	-2.7	0
1	CR+SH+PT_EOC	501	411	-99.3	0	-45.1	0	5.3	0
2	CR+SH+PT_EOC	502	410	-20.6	0	-10.3	0	6.4	0
3	CR+SH+PT_EOC	503	409	25.7	0	15.3	0	6.7	0
4	CR+SH+PT_EOC	504	408	53.5	0	40.9	0	7	0
5	CR+SH+PT_EOC	505	407	61.7	0	78.7	0	6.1	0
6	CR+SH+PT_EOC	601	411	86.5	0	-68.2	0	-5.1	0
7	CR+SH+PT_EOC	602	410	23.7	0	-19.7	0	-4.4	0
8	CR+SH+PT_EOC	603	409	-21.4	0	19.6	0	-3	0
9	CR+SH+PT_EOC	604	408	-50.9	0	52.4	0	-1.5	0
10	CR+SH+PT_EOC	605	407	-56.4	0	70.6	0	-2.2	0

Load (Row) Number	User's Load ID	Member ID	Joint ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)
1	DC	501	411	-4.3	0	14.9	0	384.5	0
2	DC	502	410	6.3	0	17	0	251.7	0
3	DC	503	409	14.9	0	19.5	0	147.5	0
4	DC	504	408	19.9	0	22.9	0	71.5	0
5	DC	505	407	16.2	0	25.5	0	23.1	0
6	DC	601	411	-12	0	20.4	0	-140.1	0
7	DC	602	410	-13.6	0	20.8	0	-102	0
8	DC	603	409	-12.1	0	19	0	-69.6	0
9	DC	604	408	-10.2	0	16.9	0	-43.3	0
10	DC	605	407	-6.6	0	13.3	0	-23.2	0
1	DW	501	411	1.4	0	0.7	0	0.9	0
2	DW	502	410	10	0	5.1	0	1.2	0
3	DW	503	409	14.3	0	8.5	0	1.2	0
4	DW	504	408	15.8	0	12	0	1	0
5	DW	505	407	13.2	0	16.8	0	0.7	0
6	DW	601	411	-6.5	0	5.1	0	0.9	0
7	DW	602	410	-9.5	0	8	0	1.1	0
8	DW	603	409	-11.7	0	10.6	0	1	0
9	DW	604	408	-13	0	13.3	0	0.8	0
10	DW	605	407	-10.5	0	13.1	0	0.7	0
1	TU-	501	411	78.1	0	35.5	0	0.6	0
2	TU-	502	410	54.9	0	27.8	0	0.4	0
3	TU-	503	409	39.6	0	23.4	0	0.9	0
4	TU-	504	408	36.7	0	28	0	1.7	0
5	TU-	505	407	65.5	0	83.5	0	3.9	0
6	TU-	601	411	-78.5	0	62	0	0.1	0
7	TU-	602	410	-55	0	46.2	0	0.1	0
8	TU-	603	409	-41.6	0	38	0	-0.6	0
9	TU-	604	408	-41.2	0	42.5	0	-1.6	0
10	TU-	605	407	-55.3	0	69.5	0	-3.3	0
1	TU+	501	411	-78.1	0	-35.5	0	-0.6	0
2	TU+	502	410	-54.9	0	-27.8	0	-0.4	0
3	TU+	503	409	-39.6	0	-23.4	0	-0.9	0
4	TU+	504	408	-36.7	0	-28	0	-1.7	0
5	TU+	505	407	-65.5	0	-83.5	0	-3.9	0
6	TU+	601	411	78.5	0	-62	0	-0.1	0
7	TU+	602	410	55	0	-46.2	0	-0.1	0
8	TU+	603	409	41.6	0	-38	0	0.6	0
9	TU+	604	408	41.2	0	-42.5	0	1.6	0
10	TU+	605	407	55.3	0	-69.5	0	3.3	0
1	TU+Temp. Diff.	501	411	-171.7	0	-78	0	0.7	0
2	TU+Temp. Diff.	502	410	-119.7	0	-60.5	0	1.5	0
3	TU+Temp. Diff.	503	409	-81.5	0	-48.1	0	1.2	0
4	TU+Temp. Diff.	504	408	-57.8	0	-44	0	0.8	0
5	TU+Temp. Diff.	505	407	-72	0	-91.8	0	-2.1	0
6	TU+Temp. Diff.	601	411	173.2	0	-136.8	0	-1.6	0
7	TU+Temp. Diff.	602	410	117.3	0	-98.4	0	-1.4	0
8	TU+Temp. Diff.	603	409	80.3	0	-73.3	0	-0.3	0
9	TU+Temp. Diff.	604	408	63.4	0	-65.3	0	0.9	0
10	TU+Temp. Diff.	605	407	65.3	0	-82	0	3.1	0
1	WS_0 DEG	501	411	0	-7.3	0	-75	0	165.6
2	WS_0 DEG	502	410	0	-6	0	-55.3	0	108.2
3	WS_0 DEG	503	409	0	-4.6	0	-39.1	0	62.3
4	WS_0 DEG	504	408	0	-3.3	0	-26.3	0	28.2
5	WS_0 DEG	505	407	0	-1.9	0	-16.9	0	5.8
6	WS_0 DEG	601	411	0	-4.6	0	-51.3	0	-58.8
7	WS_0 DEG	602	410	0	-3.9	0	-41.1	0	-42.2
8	WS_0 DEG	603	409	0	-3.2	0	-32.3	0	-28
9	WS_0 DEG	604	408	0	-2.5	0	-24.9	0	-16.5
10	WS_0 DEG	605	407	0	-1.7	0	-19.1	0	-8.2

Load (Row) Number	User's Load ID	Member ID	Joint ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)
1	WS_15 DEG	501	411	-0.5	-7.1	0.6	-72.8	19.1	160.2
2	WS_15 DEG	502	410	0.3	-5.8	0.9	-53.6	13.7	104.4
3	WS_15 DEG	503	409	0.7	-4.5	1.1	-37.8	9.2	60.1
4	WS_15 DEG	504	408	0.4	-3.2	0.9	-25.4	5.6	27.1
5	WS_15 DEG	505	407	-1.2	-1.8	-0.9	-16.3	2.9	5.4
6	WS_15 DEG	601	411	-0.9	-4.5	-0.3	-49.7	11.4	-56.8
7	WS_15 DEG	602	410	0.4	-3.8	-1.2	-39.7	8.6	-40.7
8	WS_15 DEG	603	409	1	-3.1	-1.7	-31.2	6.2	-27
9	WS_15 DEG	604	408	0.9	-2.4	-1.6	-24	4.3	-15.9
10	WS_15 DEG	605	407	0.3	-1.7	-1	-18.5	2.8	-7.9
1	WS_-15 DEG	501	411	0.5	-7.1	-0.6	-72.8	-19.1	160.2
2	WS_-15 DEG	502	410	-0.3	-5.8	-0.9	-53.6	-13.7	104.4
3	WS_-15 DEG	503	409	-0.7	-4.5	-1.1	-37.8	-9.2	60.1
4	WS_-15 DEG	504	408	-0.4	-3.2	-0.9	-25.4	-5.6	27.1
5	WS_-15 DEG	505	407	1.2	-1.8	0.9	-16.3	-2.9	5.4
6	WS_-15 DEG	601	411	0.9	-4.5	0.3	-49.7	-11.4	-56.8
7	WS_-15 DEG	602	410	-0.4	-3.8	1.2	-39.7	-8.6	-40.7
8	WS_-15 DEG	603	409	-1	-3.1	1.7	-31.2	-6.2	-27
9	WS_-15 DEG	604	408	-0.9	-2.4	1.6	-24	-4.3	-15.9
10	WS_-15 DEG	605	407	-0.3	-1.7	1	-18.5	-2.8	-7.9
1	WS_30 DEG	501	411	-0.8	-6.3	1.3	-65	36.6	143.2
2	WS_30 DEG	502	410	0.6	-5.2	1.8	-47.9	26.3	93.4
3	WS_30 DEG	503	409	1.3	-4	2.1	-33.8	17.7	53.7
4	WS_30 DEG	504	408	0.6	-2.8	1.7	-22.7	10.7	24.2
5	WS_30 DEG	505	407	-2.7	-1.6	-2.1	-14.6	5.6	4.9
6	WS_30 DEG	601	411	-1.7	-4	-0.5	-44.4	21.9	-50.8
7	WS_30 DEG	602	410	0.7	-3.4	-2.2	-35.5	16.4	-36.4
8	WS_30 DEG	603	409	1.9	-2.8	-3.3	-27.9	11.9	-24.1
9	WS_30 DEG	604	408	1.6	-2.1	-3	-21.5	8.1	-14.2
10	WS_30 DEG	605	407	0.3	-1.5	-1.6	-16.5	5.3	-7
1	WS_-30 DEG	501	411	0.8	-6.3	-1.3	-65	-36.6	143.2
2	WS_-30 DEG	502	410	-0.6	-5.2	-1.8	-47.9	-26.3	93.4
3	WS_-30 DEG	503	409	-1.3	-4	-2.1	-33.8	-17.7	53.7
4	WS_-30 DEG	504	408	-0.6	-2.8	-1.7	-22.7	-10.7	24.2
5	WS_-30 DEG	505	407	2.7	-1.6	2.1	-14.6	-5.6	4.9
6	WS_-30 DEG	601	411	1.7	-4	0.5	-44.4	-21.9	-50.8
7	WS_-30 DEG	602	410	-0.7	-3.4	2.3	-35.5	-16.4	-36.4
8	WS_-30 DEG	603	409	-1.9	-2.8	3.3	-27.9	-11.9	-24.1
9	WS_-30 DEG	604	408	-1.6	-2.1	3	-21.5	-8.1	-14.2
10	WS_-30 DEG	605	407	-0.3	-1.5	1.6	-16.5	-5.3	-7
1	WS_45 DEG	501	411	-1.1	-5.2	1.9	-53.4	52.7	117.4
2	WS_45 DEG	502	410	0.9	-4.2	2.6	-39.4	37.8	76.5
3	WS_45 DEG	503	409	1.9	-3.3	3	-27.8	25.4	43.9
4	WS_45 DEG	504	408	0.8	-2.3	2.4	-18.6	15.4	19.7
5	WS_45 DEG	505	407	-4	-1.3	-3.2	-11.9	8	3.9
6	WS_45 DEG	601	411	-2.4	-3.3	-0.7	-36.5	31.5	-41.7
7	WS_45 DEG	602	410	1	-2.8	-3.2	-29.2	23.6	-29.9
8	WS_45 DEG	603	409	2.8	-2.3	-4.7	-22.9	17.1	-19.8
9	WS_45 DEG	604	408	2.3	-1.8	-4.3	-17.7	11.7	-11.7
10	WS_45 DEG	605	407	0.4	-1.2	-2.3	-13.6	7.6	-5.8
1	WS_-45 DEG	501	411	1.1	-5.2	-1.9	-53.4	-52.7	117.4
2	WS_-45 DEG	502	410	-0.9	-4.2	-2.6	-39.4	-37.8	76.5
3	WS_-45 DEG	503	409	-1.9	-3.3	-3	-27.8	-25.4	43.9
4	WS_-45 DEG	504	408	-0.8	-2.3	-2.4	-18.6	-15.4	19.7
5	WS_-45 DEG	505	407	4	-1.3	3.2	-11.9	-8	3.9
6	WS_-45 DEG	601	411	2.4	-3.3	0.7	-36.5	-31.5	-41.7
7	WS_-45 DEG	602	410	-1	-2.8	3.2	-29.2	-23.6	-29.9
8	WS_-45 DEG	603	409	-2.8	-2.3	4.7	-22.9	-17.1	-19.8
9	WS_-45 DEG	604	408	-2.3	-1.8	4.3	-17.7	-11.7	-11.7
10	WS_-45 DEG	605	407	-0.4	-1.2	2.3	-13.6	-7.6	-5.8

Load (Row) Number	User's Load ID	Member ID	Joint ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)
1	WS_60 DEG	501	411	-1.4	-3.6	2.2	-37.2	64.1	81.3
2	WS_60 DEG	502	410	1	-2.9	3.1	-27.4	46	52.8
3	WS_60 DEG	503	409	2.3	-2.3	3.7	-19.3	31	30.2
4	WS_60 DEG	504	408	1	-1.6	2.9	-12.9	18.7	13.4
5	WS_60 DEG	505	407	-4.9	-0.9	-3.9	-8.2	9.7	2.6
6	WS_60 DEG	601	411	-2.9	-2.3	-0.9	-25.3	38.3	-29
7	WS_60 DEG	602	410	1.3	-1.9	-3.9	-20.3	28.8	-20.8
8	WS_60 DEG	603	409	3.4	-1.6	-5.7	-15.9	20.8	-13.8
9	WS_60 DEG	604	408	2.8	-1.2	-5.2	-12.3	14.2	-8.1
10	WS_60 DEG	605	407	0.5	-0.9	-2.8	-9.5	9.2	-4.1
1	WS_-60 DEG	501	411	1.3	-3.6	-2.3	-37.2	-64.1	81.3
2	WS_-60 DEG	502	410	-1.1	-2.9	-3.1	-27.4	-46	52.8
3	WS_-60 DEG	503	409	-2.3	-2.3	-3.7	-19.3	-31	30.2
4	WS_-60 DEG	504	408	-1	-1.6	-2.9	-12.9	-18.7	13.4
5	WS_-60 DEG	505	407	4.9	-0.9	3.9	-8.2	-9.7	2.6
6	WS_-60 DEG	601	411	2.9	-2.3	0.9	-25.3	-38.3	-29
7	WS_-60 DEG	602	410	-1.2	-1.9	3.9	-20.3	-28.8	-20.8
8	WS_-60 DEG	603	409	-3.4	-1.6	5.7	-15.9	-20.8	-13.8
9	WS_-60 DEG	604	408	-2.8	-1.2	5.2	-12.3	-14.2	-8.1
10	WS_-60 DEG	605	407	-0.5	-0.9	2.8	-9.5	-9.2	-4.1
1	WS+WUP	501	411	-2.4	-7.4	-1.1	-74.1	0.1	169.6
2	WS+WUP	502	410	-12.7	-6	-6.4	-54.8	-1.9	112.1
3	WS+WUP	503	409	-18.1	-4.7	-10.7	-39.1	-1.5	66.2
4	WS+WUP	504	408	-20.5	-3.4	-15.6	-27.1	-1.4	32.4
5	WS+WUP	505	407	-17.5	-2.1	-22.3	-19	-0.9	9
6	WS+WUP	601	411	8.7	-4.6	-6.9	-51.9	-1.2	-59.9
7	WS+WUP	602	410	12.4	-3.9	-10.4	-41.6	-1.4	-43.1
8	WS+WUP	603	409	15.1	-3.2	-13.8	-32.7	-1.3	-28.6
9	WS+WUP	604	408	16.4	-2.5	-16.8	-25.2	-1.1	-16.9
10	WS+WUP	605	407	14.1	-1.7	-17.5	-19.7	-0.6	-9

Sum-It: AASHTO LRFD Load Combination Generator
Figg Bridge Engineers, Inc.
Combined Limit States Summary
File Name: Canopy Anchor Forces_Global.sum

Selected Limit States

STR 1 - STRENGTH I
STR 3 - STRENGTH III

Max/ Min ID	Load Num	Member Num	Joint Num	Limit State/ Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
Max Fx	1	501	106	STR 3/ 119	402.9	-5.0	200.0	52.6	-363.7	-114.8	367.5	126.3	381.4
Max Fy	1	501	106	STR 1/ 7	59.2	0.2	47.7	-7.5	-463.1	7.2	463.2	10.4	463.2
Max Fz	6	601	156	STR 3/ 120	-350.0	-6.7	289.8	79.5	149.8	92.7	169.6	122.1	176.2
Max Mx	1	501	106	STR 3/ 1	63.5	-10.2	49.8	104.3	-465.4	-230.3	476.9	252.8	519.3
Max My	6	601	156	STR 3/ 9	-15.2	-3.4	29.9	39.8	221.3	46.1	224.8	60.8	226.0
Max Mz	6	601	156	STR 3/ 1	-22.5	-6.7	31.2	80.6	162.4	93.4	181.3	123.4	187.3
Max Mxy	1	501	106	STR 3/ 65	48.9	-5.0	47.3	52.6	-558.0	-114.8	560.5	126.3	569.7
Max Mxz	1	501	106	STR 3/ 1	63.5	-10.2	49.8	104.3	-465.4	-230.3	476.9	252.8	519.3
Max Myz	1	501	106	STR 3/ 65	48.9	-5.0	47.3	52.6	-558.0	-114.8	560.5	126.3	569.7
Min Fx	6	601	156	STR 3/ 240	-354.2	-6.7	289.3	79.5	102.7	92.7	129.8	122.1	138.3
Min Fy	1	501	106	STR 3/ 1	63.5	-10.2	49.8	104.3	-465.4	-230.3	476.9	252.8	519.3
Min Fz	5	505	126	STR 1/ 28	-268.1	0.0	-335.5	0.0	-18.5	0.0	18.5	0.0	18.5
Min Mx	1	501	106	STR 1/ 8	69.5	0.2	52.4	-8.2	-462.3	7.9	462.3	11.4	462.3
Min My	1	501	106	STR 3/ 65	48.9	-5.0	47.3	52.6	-558.0	-114.8	560.5	126.3	569.7
Min Mz	1	501	106	STR 3/ 1	63.5	-10.2	49.8	104.3	-465.4	-230.3	476.9	252.8	519.3
Min Mxy	5	505	126	STR 1/ 83	-254.5	0.0	-320.1	0.0	-7.8	0.0	7.8	0.0	7.8
Min Mxz	1	501	106	STR 1/ 1	54.6	0.0	45.6	0.0	-460.9	0.0	460.9	0.0	460.9
Min Myz	5	505	126	STR 1/ 83	-254.5	0.0	-320.1	0.0	-7.8	0.0	7.8	0.0	7.8

Sum-It: AASHTO LRFD Load Combination Generator
Figg Bridge Engineers, Inc.
Combined Limit States Results
File Name: Canopy Anchor Forces_Global.sum

Selected Limit States

STR 1 - STRENGTH I
STR 3 - STRENGTH III

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 3/ 119	402.9	-5.0	200.0	52.6	-363.7	-114.8	367.5	126.3	381.4
	Max Fy	STR 1/ 7	59.2	0.2	47.7	-7.5	-463.1	7.2	463.2	10.4	463.2
	Max Fz	STR 1/ 155	398.8	0.0	202.0	0.0	-449.6	0.0	449.6	0.0	449.6
	Max Mx	STR 3/ 1	63.5	-10.2	49.8	104.3	-465.4	-230.3	476.9	252.8	519.3
	Max My	STR 3/ 179	400.2	-5.0	192.8	52.6	-230.3	-114.8	236.3	126.3	257.4
Load No.	Max Mz	STR 1/ 8	69.5	0.2	52.4	-8.2	-462.3	7.9	462.3	11.4	462.3
1	Max Mxy	STR 3/ 65	48.9	-5.0	47.3	52.6	-558.0	-114.8	560.5	126.3	569.7
	Max Mxz	STR 3/ 1	63.5	-10.2	49.8	104.3	-465.4	-230.3	476.9	252.8	519.3
Member	Max Myz	STR 3/ 65	48.9	-5.0	47.3	52.6	-558.0	-114.8	560.5	126.3	569.7
501	Min Fx	STR 1/ 57	41.4	0.0	33.8	0.0	-334.2	0.0	334.2	0.0	334.2
	Min Fy	STR 3/ 1	63.5	-10.2	49.8	104.3	-465.4	-230.3	476.9	252.8	519.3
Joint	Min Fz	STR 1/ 57	41.4	0.0	33.8	0.0	-334.2	0.0	334.2	0.0	334.2
106	Min Mx	STR 1/ 8	69.5	0.2	52.4	-8.2	-462.3	7.9	462.3	11.4	462.3
	Min My	STR 3/ 65	48.9	-5.0	47.3	52.6	-558.0	-114.8	560.5	126.3	569.7
	Min Mz	STR 3/ 1	63.5	-10.2	49.8	104.3	-465.4	-230.3	476.9	252.8	519.3
	Min Mxy	STR 3/ 179	400.2	-5.0	192.8	52.6	-230.3	-114.8	236.3	126.3	257.4
	Min Mxz	STR 1/ 1	54.6	0.0	45.6	0.0	-460.9	0.0	460.9	0.0	460.9
	Min Myz	STR 3/ 179	400.2	-5.0	192.8	52.6	-230.3	-114.8	236.3	126.3	257.4
	Max Fx	STR 3/ 240	162.7	-8.3	94.1	70.4	-208.1	-144.5	219.7	160.7	253.3
	Max Fy	STR 1/ 7	-61.6	0.2	-14.2	-7.0	-298.4	6.7	298.4	9.7	298.4
	Max Fz	STR 3/ 120	160.5	-8.3	97.8	70.4	-295.0	-144.5	303.3	160.7	328.5
	Max Mx	STR 3/ 1	-29.7	-8.4	1.9	76.9	-301.9	-150.4	311.5	168.9	337.2
	Max My	STR 3/ 179	152.3	-4.2	85.2	39.1	-136.5	-75.3	141.9	84.8	155.9
Load No.	Max Mz	STR 1/ 8	-51.3	0.2	-9.2	-8.1	-297.1	7.7	297.2	11.1	297.2
2	Max Mxy	STR 3/ 65	-37.2	-4.2	1.9	39.1	-370.8	-75.3	372.9	84.8	378.4
	Max Mxz	STR 3/ 1	-29.7	-8.4	1.9	76.9	-301.9	-150.4	311.5	168.9	337.2
Member	Max Myz	STR 3/ 65	-37.2	-4.2	1.9	39.1	-370.8	-75.3	372.9	84.8	378.4
502	Min Fx	STR 1/ 1	-93.4	0.0	-30.5	0.0	-294.9	0.0	294.9	0.0	294.9
	Min Fy	STR 3/ 1	-29.7	-8.4	1.9	76.9	-301.9	-150.4	311.5	168.9	337.2
Joint	Min Fz	STR 1/ 55	-91.2	0.0	-34.2	0.0	-207.9	0.0	207.9	0.0	207.9
111	Min Mx	STR 1/ 8	-51.3	0.2	-9.2	-8.1	-297.1	7.7	297.2	11.1	297.2
	Min My	STR 3/ 65	-37.2	-4.2	1.9	39.1	-370.8	-75.3	372.9	84.8	378.4
	Min Mz	STR 3/ 1	-29.7	-8.4	1.9	76.9	-301.9	-150.4	311.5	168.9	337.2
	Min Mxy	STR 3/ 179	152.3	-4.2	85.2	39.1	-136.5	-75.3	141.9	84.8	155.9
	Min Mxz	STR 1/ 1	-93.4	0.0	-30.5	0.0	-294.9	0.0	294.9	0.0	294.9
	Min Myz	STR 3/ 179	152.3	-4.2	85.2	39.1	-136.5	-75.3	141.9	84.8	155.9

Sum-It: AASHTO LRFD Load Combination Generator
Figg Bridge Engineers, Inc.
Combined Limit States Results
File Name: Canopy Anchor Forces_Global.sum

	Combinded Results										
	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 3/ 240	27.0	-6.4	25.2	49.3	-118.6	-83.4	128.5	96.9	145.0
	Max Fy	STR 1/ 7	-131.3	0.2	-64.5	-6.3	-171.5	5.4	171.6	8.3	171.6
	Max Fz	STR 3/ 120	21.8	-6.4	25.9	49.3	-169.4	-83.4	176.4	96.9	188.8
	Max Mx	STR 3/ 1	-85.6	-6.6	-37.4	55.7	-174.2	-89.0	182.8	105.0	195.6
	Max My	STR 3/ 159	-56.6	-3.2	-27.6	28.6	-69.5	-44.8	75.1	53.1	82.7
Load No.	Max Mz	STR 1/ 8	-120.4	0.2	-58.0	-7.7	-170.5	6.8	170.6	10.3	170.6
3	Max Mxy	STR 3/ 75	-48.2	-3.2	-11.9	28.6	-222.5	-44.8	224.4	53.1	227.0
	Max Mxz	STR 3/ 1	-85.6	-6.6	-37.4	55.7	-174.2	-89.0	182.8	105.0	195.6
Member	Max Myz	STR 3/ 75	-48.2	-3.2	-11.9	28.6	-222.5	-44.8	224.4	53.1	227.0
503	Min Fx	STR 1/ 1	-176.9	0.0	-91.5	0.0	-169.1	0.0	169.1	0.0	169.1
	Min Fy	STR 3/ 1	-85.6	-6.6	-37.4	55.7	-174.2	-89.0	182.8	105.0	195.6
Joint	Min Fz	STR 1/ 55	-171.7	0.0	-92.1	0.0	-118.3	0.0	118.3	0.0	118.3
116	Min Mx	STR 1/ 8	-120.4	0.2	-58.0	-7.7	-170.5	6.8	170.6	10.3	170.6
	Min My	STR 3/ 75	-48.2	-3.2	-11.9	28.6	-222.5	-44.8	224.4	53.1	227.0
	Min Mz	STR 3/ 1	-85.6	-6.6	-37.4	55.7	-174.2	-89.0	182.8	105.0	195.6
	Min Mxy	STR 3/ 159	-56.6	-3.2	-27.6	28.6	-69.5	-44.8	75.1	53.1	82.7
	Min Mxz	STR 1/ 1	-176.9	0.0	-91.5	0.0	-169.1	0.0	169.1	0.0	169.1
	Min Myz	STR 3/ 159	-56.6	-3.2	-27.6	28.6	-69.5	-44.8	75.1	53.1	82.7
	Max Fx	STR 3/ 210	-24.1	-4.6	-11.5	34.2	-59.4	-40.3	68.5	52.8	71.8
	Max Fy	STR 1/ 7	-170.8	0.2	-120.7	-5.8	-78.8	4.0	79.0	7.0	78.9
	Max Fz	STR 3/ 210	-24.1	-4.6	-11.5	34.2	-59.4	-40.3	68.5	52.8	71.8
	Max Mx	STR 3/ 1	-120.4	-4.8	-82.2	41.7	-80.9	-45.9	91.0	62.0	93.0
	Max My	STR 3/ 159	-134.0	-2.4	-98.7	21.4	-20.5	-23.2	29.7	31.6	31.0
Load No.	Max Mz	STR 1/ 8	-160.5	0.2	-112.8	-7.7	-77.5	5.8	77.9	9.6	77.7
4	Max Mxy	STR 3/ 75	-79.8	-2.4	-48.0	21.4	-112.8	-23.2	114.9	31.6	115.2
	Max Mxz	STR 3/ 1	-120.4	-4.8	-82.2	41.7	-80.9	-45.9	91.0	62.0	93.0
Member	Max Myz	STR 3/ 75	-79.8	-2.4	-48.0	21.4	-112.8	-23.2	114.9	31.6	115.2
504	Min Fx	STR 1/ 28	-251.3	0.0	-182.2	0.0	-70.5	0.0	70.5	0.0	70.5
	Min Fy	STR 3/ 1	-120.4	-4.8	-82.2	41.7	-80.9	-45.9	91.0	62.0	93.0
Joint	Min Fz	STR 1/ 28	-251.3	0.0	-182.2	0.0	-70.5	0.0	70.5	0.0	70.5
121	Min Mx	STR 1/ 8	-160.5	0.2	-112.8	-7.7	-77.5	5.8	77.9	9.6	77.7
	Min My	STR 3/ 75	-79.8	-2.4	-48.0	21.4	-112.8	-23.2	114.9	31.6	115.2
	Min Mz	STR 3/ 1	-120.4	-4.8	-82.2	41.7	-80.9	-45.9	91.0	62.0	93.0
	Min Mxy	STR 3/ 159	-134.0	-2.4	-98.7	21.4	-20.5	-23.2	29.7	31.6	31.0
	Min Mxz	STR 1/ 1	-221.2	0.0	-159.0	0.0	-76.7	0.0	76.7	0.0	76.7
	Min Myz	STR 3/ 159	-134.0	-2.4	-98.7	21.4	-20.5	-23.2	29.7	31.6	31.0

Combinded Results

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 3/ 210	-24.4	-3.2	-26.5	31.1	-20.9	-16.1	37.4	35.0	26.4
	Max Fy	STR 1/ 8	-172.7	0.2	-213.9	-4.4	-21.2	1.9	21.7	4.8	21.3
	Max Fz	STR 3/ 210	-24.4	-3.2	-26.5	31.1	-20.9	-16.1	37.4	35.0	26.4
	Max Mx	STR 3/ 1	-134.5	-3.5	-165.0	39.1	-23.5	-20.3	45.6	44.0	31.1
	Max My	STR 3/ 159	-179.6	-1.7	-228.1	19.9	3.9	-10.2	20.3	22.4	10.9
Load No.	Max Mz	STR 1/ 8	-172.7	0.2	-213.9	-4.4	-21.2	1.9	21.7	4.8	21.3
5	Max Mxy	STR 3/ 83	-53.7	-3.1	-60.2	34.2	-37.6	-17.6	50.8	38.4	41.5
	Max Mxz	STR 3/ 1	-134.5	-3.5	-165.0	39.1	-23.5	-20.3	45.6	44.0	31.1
Member	Max Myz	STR 3/ 85	-53.0	-1.7	-57.6	19.9	-44.6	-10.2	48.8	22.4	45.8
505	Min Fx	STR 1/ 28	-268.1	0.0	-335.5	0.0	-18.5	0.0	18.5	0.0	18.5
	Min Fy	STR 3/ 1	-134.5	-3.5	-165.0	39.1	-23.5	-20.3	45.6	44.0	31.1
Joint	Min Fz	STR 1/ 28	-268.1	0.0	-335.5	0.0	-18.5	0.0	18.5	0.0	18.5
126	Min Mx	STR 1/ 8	-172.7	0.2	-213.9	-4.4	-21.2	1.9	21.7	4.8	21.3
	Min My	STR 3/ 85	-53.0	-1.7	-57.6	19.9	-44.6	-10.2	48.8	22.4	45.8
	Min Mz	STR 3/ 1	-134.5	-3.5	-165.0	39.1	-23.5	-20.3	45.6	44.0	31.1
	Min Mxy	STR 1/ 83	-254.5	0.0	-320.1	0.0	-7.8	0.0	7.8	0.0	7.8
	Min Mxz	STR 1/ 1	-218.9	0.0	-272.5	0.0	-21.6	0.0	21.6	0.0	21.6
	Min Myz	STR 1/ 83	-254.5	0.0	-320.1	0.0	-7.8	0.0	7.8	0.0	7.8
	Max Fx	STR 1/ 1	18.8	0.0	-1.4	0.0	166.2	0.0	166.2	0.0	166.2
	Max Fy	STR 1/ 1	18.8	0.0	-1.4	0.0	166.2	0.0	166.2	0.0	166.2
	Max Fz	STR 3/ 120	-350.0	-6.7	289.8	79.5	149.8	92.7	169.6	122.1	176.2
	Max Mx	STR 3/ 1	-22.5	-6.7	31.2	80.6	162.4	93.4	181.3	123.4	187.3
	Max My	STR 3/ 9	-15.2	-3.4	29.9	39.8	221.3	46.1	224.8	60.8	226.0
Load No.	Max Mz	STR 3/ 1	-22.5	-6.7	31.2	80.6	162.4	93.4	181.3	123.4	187.3
6	Max Mxy	STR 3/ 9	-15.2	-3.4	29.9	39.8	221.3	46.1	224.8	60.8	226.0
	Max Mxz	STR 3/ 1	-22.5	-6.7	31.2	80.6	162.4	93.4	181.3	123.4	187.3
Member	Max Myz	STR 3/ 9	-15.2	-3.4	29.9	39.8	221.3	46.1	224.8	60.8	226.0
601	Min Fx	STR 3/ 240	-354.2	-6.7	289.3	79.5	102.7	92.7	129.8	122.1	138.3
	Min Fy	STR 3/ 1	-22.5	-6.7	31.2	80.6	162.4	93.4	181.3	123.4	187.3
Joint	Min Fz	STR 1/ 55	14.6	0.0	-1.8	0.0	119.0	0.0	119.0	0.0	119.0
156	Min Mx	STR 1/ 9	-19.9	0.0	29.1	-3.7	160.3	-3.2	160.3	4.8	160.3
	Min My	STR 3/ 235	-349.4	-3.4	280.9	39.8	45.0	46.1	60.0	60.8	64.4
	Min Mz	STR 1/ 9	-19.9	0.0	29.1	-3.7	160.3	-3.2	160.3	4.8	160.3
	Min Mxy	STR 3/ 235	-349.4	-3.4	280.9	39.8	45.0	46.1	60.0	60.8	64.4
	Min Mxz	STR 1/ 1	18.8	0.0	-1.4	0.0	166.2	0.0	166.2	0.0	166.2
	Min Myz	STR 3/ 235	-349.4	-3.4	280.9	39.8	45.0	46.1	60.0	60.8	64.4

Combinded Results

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 1/ 1	96.0	0.0	-69.0	0.0	122.4	0.0	122.4	0.0	122.4
	Max Fy	STR 1/ 1	96.0	0.0	-69.0	0.0	122.4	0.0	122.4	0.0	122.4
	Max Fz	STR 3/ 240	-158.7	-5.9	141.3	67.6	73.8	71.5	100.1	98.4	102.8
	Max Mx	STR 3/ 1	35.1	-5.9	-18.0	68.2	117.5	71.7	135.8	98.9	137.6
	Max My	STR 3/ 9	46.7	-2.9	-23.5	33.6	164.0	35.3	167.4	48.7	167.7
Load No.	Max Mz	STR 3/ 1	35.1	-5.9	-18.0	68.2	117.5	71.7	135.8	98.9	137.6
7	Max Mxy	STR 3/ 9	46.7	-2.9	-23.5	33.6	164.0	35.3	167.4	48.7	167.7
	Max Mxz	STR 3/ 1	35.1	-5.9	-18.0	68.2	117.5	71.7	135.8	98.9	137.6
Member	Max Myz	STR 3/ 9	46.7	-2.9	-23.5	33.6	164.0	35.3	167.4	48.7	167.7
602	Min Fx	STR 3/ 240	-158.7	-5.9	141.3	67.6	73.8	71.5	100.1	98.4	102.8
	Min Fy	STR 3/ 1	35.1	-5.9	-18.0	68.2	117.5	71.7	135.8	98.9	137.6
Joint	Min Fz	STR 1/ 1	96.0	0.0	-69.0	0.0	122.4	0.0	122.4	0.0	122.4
151	Min Mx	STR 1/ 9	44.2	0.0	-25.7	-2.8	114.9	-2.3	114.9	3.6	114.9
	Min My	STR 3/ 235	-153.0	-2.9	132.2	33.6	28.7	35.3	44.2	48.7	45.5
	Min Mz	STR 1/ 9	44.2	0.0	-25.7	-2.8	114.9	-2.3	114.9	3.6	114.9
	Min Mxy	STR 3/ 235	-153.0	-2.9	132.2	33.6	28.7	35.3	44.2	48.7	45.5
	Min Mxz	STR 1/ 1	96.0	0.0	-69.0	0.0	122.4	0.0	122.4	0.0	122.4
	Min Myz	STR 3/ 235	-153.0	-2.9	132.2	33.6	28.7	35.3	44.2	48.7	45.5
	Max Fx	STR 1/ 1	149.8	0.0	-126.6	0.0	85.3	0.0	85.3	0.0	85.3
	Max Fy	STR 1/ 1	149.8	0.0	-126.6	0.0	85.3	0.0	85.3	0.0	85.3
	Max Fz	STR 3/ 240	-32.7	-5.0	36.8	58.9	54.6	54.5	80.3	80.2	77.1
	Max Mx	STR 3/ 10	53.7	-5.0	-39.2	58.9	79.0	54.5	98.6	80.2	96.0
	Max My	STR 3/ 19	46.3	-2.5	-28.5	28.7	116.5	26.5	120.0	39.0	119.5
Load No.	Max Mz	STR 3/ 10	53.7	-5.0	-39.2	58.9	79.0	54.5	98.6	80.2	96.0
8	Max Mxy	STR 3/ 19	46.3	-2.5	-28.5	28.7	116.5	26.5	120.0	39.0	119.5
	Max Mxz	STR 3/ 10	53.7	-5.0	-39.2	58.9	79.0	54.5	98.6	80.2	96.0
Member	Max Myz	STR 3/ 19	46.3	-2.5	-28.5	28.7	116.5	26.5	120.0	39.0	119.5
603	Min Fx	STR 3/ 240	-32.7	-5.0	36.8	58.9	54.6	54.5	80.3	80.2	77.1
	Min Fy	STR 3/ 1	74.9	-5.0	-58.5	58.7	80.4	54.0	99.5	79.8	96.9
Joint	Min Fz	STR 1/ 1	149.8	0.0	-126.6	0.0	85.3	0.0	85.3	0.0	85.3
146	Min Mx	STR 1/ 9	87.7	0.0	-70.2	-1.6	78.2	-1.2	78.2	2.0	78.2
	Min My	STR 3/ 215	36.4	-2.5	-30.2	28.7	20.3	26.5	35.2	39.0	33.3
	Min Mz	STR 1/ 9	87.7	0.0	-70.2	-1.6	78.2	-1.2	78.2	2.0	78.2
	Min Mxy	STR 3/ 215	36.4	-2.5	-30.2	28.7	20.3	26.5	35.2	39.0	33.3
	Min Mxz	STR 1/ 1	149.8	0.0	-126.6	0.0	85.3	0.0	85.3	0.0	85.3
	Min Myz	STR 3/ 215	36.4	-2.5	-30.2	28.7	20.3	26.5	35.2	39.0	33.3

Combinded Results

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 1/ 28	212.0	0.0	-210.1	0.0	59.8	0.0	59.8	0.0	59.8
	Max Fy	STR 1/ 1	186.7	0.0	-184.1	0.0	57.3	0.0	57.3	0.0	57.3
	Max Fz	STR 3/ 210	13.9	-4.3	-8.7	53.1	37.7	40.9	65.1	67.0	55.6
	Max Mx	STR 3/ 10	80.8	-4.3	-75.3	53.1	50.2	40.9	73.1	67.0	64.8
	Max My	STR 3/ 49	98.5	-2.1	-89.6	25.5	82.5	19.3	86.3	32.0	84.7
Load No.	Max Mz	STR 3/ 10	80.8	-4.3	-75.3	53.1	50.2	40.9	73.1	67.0	64.8
9	Max Mxy	STR 3/ 48	96.5	-3.1	-88.4	37.0	78.1	28.3	86.4	46.5	83.1
	Max Mxz	STR 3/ 10	80.8	-4.3	-75.3	53.1	50.2	40.9	73.1	67.0	64.8
Member	Max Myz	STR 3/ 49	98.5	-2.1	-89.6	25.5	82.5	19.3	86.3	32.0	84.7
604	Min Fx	STR 3/ 210	13.9	-4.3	-8.7	53.1	37.7	40.9	65.1	67.0	55.6
	Min Fy	STR 3/ 1	103.8	-4.3	-98.9	52.2	51.9	39.9	73.6	65.7	65.5
Joint	Min Fz	STR 1/ 28	212.0	0.0	-210.1	0.0	59.8	0.0	59.8	0.0	59.8
141	Min Mx	STR 1/ 9	120.0	0.0	-115.8	-0.4	50.3	-0.2	50.3	0.4	50.3
	Min My	STR 3/ 185	78.5	-2.1	-78.8	25.5	11.3	19.3	27.9	32.0	22.4
	Min Mz	STR 1/ 9	120.0	0.0	-115.8	-0.4	50.3	-0.2	50.3	0.4	50.3
	Min Mxy	STR 3/ 185	78.5	-2.1	-78.8	25.5	11.3	19.3	27.9	32.0	22.4
	Min Mxz	STR 1/ 1	186.7	0.0	-184.1	0.0	57.3	0.0	57.3	0.0	57.3
	Min Myz	STR 3/ 185	78.5	-2.1	-78.8	25.5	11.3	19.3	27.9	32.0	22.4
	Max Fx	STR 1/ 28	209.2	0.0	-255.3	0.0	33.7	0.0	33.7	0.0	33.7
	Max Fy	STR 1/ 1	175.3	0.0	-212.9	0.0	32.1	0.0	32.1	0.0	32.1
	Max Fz	STR 3/ 210	16.8	-3.6	-16.7	47.9	21.9	29.0	52.6	56.0	36.3
	Max Mx	STR 3/ 1	108.1	-3.6	-129.3	48.2	26.0	28.6	54.7	56.0	38.6
	Max My	STR 3/ 59	87.5	-1.8	-99.8	23.2	49.7	13.7	54.9	27.0	51.6
Load No.	Max Mz	STR 3/ 10	88.3	-3.6	-104.8	47.9	25.0	29.0	54.0	56.0	38.3
10	Max Mxy	STR 3/ 56	83.6	-3.5	-97.3	46.6	38.1	27.6	60.2	54.2	47.1
	Max Mxz	STR 3/ 1	108.1	-3.6	-129.3	48.2	26.0	28.6	54.7	56.0	38.6
Member	Max Myz	STR 3/ 59	87.5	-1.8	-99.8	23.2	49.7	13.7	54.9	27.0	51.6
605	Min Fx	STR 3/ 210	16.8	-3.6	-16.7	47.9	21.9	29.0	52.6	56.0	36.3
	Min Fy	STR 3/ 1	108.1	-3.6	-129.3	48.2	26.0	28.6	54.7	56.0	38.6
Joint	Min Fz	STR 1/ 28	209.2	0.0	-255.3	0.0	33.7	0.0	33.7	0.0	33.7
136	Min Mx	STR 1/ 1	175.3	0.0	-212.9	0.0	32.1	0.0	32.1	0.0	32.1
	Min My	STR 3/ 185	90.9	-1.8	-113.0	23.2	0.7	13.7	23.2	27.0	13.7
	Min Mz	STR 1/ 1	175.3	0.0	-212.9	0.0	32.1	0.0	32.1	0.0	32.1
	Min Mxy	STR 1/ 165	124.8	0.0	-152.1	0.0	16.0	0.0	16.0	0.0	16.0
	Min Mxz	STR 1/ 1	175.3	0.0	-212.9	0.0	32.1	0.0	32.1	0.0	32.1
	Min Myz	STR 3/ 185	90.9	-1.8	-113.0	23.2	0.7	13.7	23.2	27.0	13.7

Sum-It: AASHTO LRFD Load Combination Generator
Figg Bridge Engineers, Inc.
Limit State Summary
File Name: Canopy Anchor Forces_Global.sum

AASHTO Limit State: STR 1 - STRENGTH I

Max/ Min ID	Load Num	Member Num	Joint Num	Limit State/ Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
Max Fx	1	501	106	STR 1/ 155	398.8	0.0	202.0	0.0	-449.6	0.0	449.6	0.0	449.6
Max Fy	1	501	106	STR 1/ 7	59.2	0.2	47.7	-7.5	-463.1	7.2	463.2	10.4	463.2
Max Fz	6	601	156	STR 1/ 159	-336.9	0.0	279.4	0.0	150.7	0.0	150.7	0.0	150.7
Max Mx	10	605	136	STR 1/ 7	141.7	-0.2	-171.1	6.7	29.1	4.7	29.9	8.2	29.5
Max My	6	601	156	STR 1/ 2	13.7	0.0	2.8	0.0	170.4	0.0	170.4	0.0	170.4
Max Mz	1	501	106	STR 1/ 8	69.5	0.2	52.4	-8.2	-462.3	7.9	462.3	11.4	462.3
Max Mxy	1	501	106	STR 1/ 112	62.6	0.0	49.5	0.0	-469.7	0.0	469.7	0.0	469.7
Max Mxz	1	501	106	STR 1/ 8	69.5	0.2	52.4	-8.2	-462.3	7.9	462.3	11.4	462.3
Max Myz	1	501	106	STR 1/ 112	62.6	0.0	49.5	0.0	-469.7	0.0	469.7	0.0	469.7
Min Fx	6	601	156	STR 1/ 213	-341.1	0.0	279.0	0.0	103.6	0.0	103.6	0.0	103.6
Min Fy	5	505	126	STR 1/ 9	-138.5	-0.2	-169.9	2.6	-24.7	-1.8	24.9	3.2	24.8
Min Fz	5	505	126	STR 1/ 28	-268.1	0.0	-335.5	0.0	-18.5	0.0	18.5	0.0	18.5
Min Mx	1	501	106	STR 1/ 8	69.5	0.2	52.4	-8.2	-462.3	7.9	462.3	11.4	462.3
Min My	1	501	106	STR 1/ 112	62.6	0.0	49.5	0.0	-469.7	0.0	469.7	0.0	469.7
Min Mz	6	601	156	STR 1/ 9	-19.9	0.0	29.1	-3.7	160.3	-3.2	160.3	4.8	160.3
Min Mxy	5	505	126	STR 1/ 83	-254.5	0.0	-320.1	0.0	-7.8	0.0	7.8	0.0	7.8
Min Mxz	1	501	106	STR 1/ 1	54.6	0.0	45.6	0.0	-460.9	0.0	460.9	0.0	460.9
Min Myz	5	505	126	STR 1/ 83	-254.5	0.0	-320.1	0.0	-7.8	0.0	7.8	0.0	7.8

AASHTO Limit State: STR 1 - STRENGTH I

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 1/ 155	398.8	0.0	202.0	0.0	-449.6	0.0	449.6	0.0	449.6
	Max Fy	STR 1/ 7	59.2	0.2	47.7	-7.5	-463.1	7.2	463.2	10.4	463.2
	Max Fz	STR 1/ 155	398.8	0.0	202.0	0.0	-449.6	0.0	449.6	0.0	449.6
	Max Mx	STR 1/ 9	53.2	0.0	45.1	0.9	-466.3	-0.7	466.3	1.1	466.3
	Max My	STR 1/ 101	396.1	0.0	194.8	0.0	-316.2	0.0	316.2	0.0	316.2
Load No.	Max Mz	STR 1/ 8	69.5	0.2	52.4	-8.2	-462.3	7.9	462.3	11.4	462.3
1	Max Mxy	STR 1/ 112	62.6	0.0	49.5	0.0	-469.7	0.0	469.7	0.0	469.7
	Max Mxz	STR 1/ 8	69.5	0.2	52.4	-8.2	-462.3	7.9	462.3	11.4	462.3
Member	Max Myz	STR 1/ 112	62.6	0.0	49.5	0.0	-469.7	0.0	469.7	0.0	469.7
501	Min Fx	STR 1/ 57	41.4	0.0	33.8	0.0	-334.2	0.0	334.2	0.0	334.2
	Min Fy	STR 1/ 1	54.6	0.0	45.6	0.0	-460.9	0.0	460.9	0.0	460.9
Joint	Min Fz	STR 1/ 57	41.4	0.0	33.8	0.0	-334.2	0.0	334.2	0.0	334.2
106	Min Mx	STR 1/ 8	69.5	0.2	52.4	-8.2	-462.3	7.9	462.3	11.4	462.3
	Min My	STR 1/ 112	62.6	0.0	49.5	0.0	-469.7	0.0	469.7	0.0	469.7
	Min Mz	STR 1/ 9	53.2	0.0	45.1	0.9	-466.3	-0.7	466.3	1.1	466.3
	Min Mxy	STR 1/ 101	396.1	0.0	194.8	0.0	-316.2	0.0	316.2	0.0	316.2
	Min Mxz	STR 1/ 1	54.6	0.0	45.6	0.0	-460.9	0.0	460.9	0.0	460.9
	Min Myz	STR 1/ 101	396.1	0.0	194.8	0.0	-316.2	0.0	316.2	0.0	316.2
	Max Fx	STR 1/ 213	142.6	0.0	84.0	0.0	-205.6	0.0	205.6	0.0	205.6
	Max Fy	STR 1/ 7	-61.6	0.2	-14.2	-7.0	-298.4	6.7	298.4	9.7	298.4
	Max Fz	STR 1/ 159	140.4	0.0	87.6	0.0	-292.6	0.0	292.6	0.0	292.6
	Max Mx	STR 1/ 9	-40.1	0.0	-3.2	1.1	-303.1	-1.1	303.1	1.5	303.1
	Max My	STR 1/ 101	93.2	0.0	58.8	0.0	-195.2	0.0	195.2	0.0	195.2
Load No.	Max Mz	STR 1/ 8	-51.3	0.2	-9.2	-8.1	-297.1	7.7	297.2	11.1	297.2
2	Max Mxy	STR 1/ 111	-41.7	0.0	-4.1	0.0	-305.1	0.0	305.1	0.0	305.1
	Max Mxz	STR 1/ 8	-51.3	0.2	-9.2	-8.1	-297.1	7.7	297.2	11.1	297.2
Member	Max Myz	STR 1/ 111	-41.7	0.0	-4.1	0.0	-305.1	0.0	305.1	0.0	305.1
502	Min Fx	STR 1/ 1	-93.4	0.0	-30.5	0.0	-294.9	0.0	294.9	0.0	294.9
	Min Fy	STR 1/ 1	-93.4	0.0	-30.5	0.0	-294.9	0.0	294.9	0.0	294.9
Joint	Min Fz	STR 1/ 55	-91.2	0.0	-34.2	0.0	-207.9	0.0	207.9	0.0	207.9
111	Min Mx	STR 1/ 8	-51.3	0.2	-9.2	-8.1	-297.1	7.7	297.2	11.1	297.2
	Min My	STR 1/ 111	-41.7	0.0	-4.1	0.0	-305.1	0.0	305.1	0.0	305.1
	Min Mz	STR 1/ 9	-40.1	0.0	-3.2	1.1	-303.1	-1.1	303.1	1.5	303.1
	Min Mxy	STR 1/ 101	93.2	0.0	58.8	0.0	-195.2	0.0	195.2	0.0	195.2
	Min Mxz	STR 1/ 1	-93.4	0.0	-30.5	0.0	-294.9	0.0	294.9	0.0	294.9
	Min Myz	STR 1/ 101	93.2	0.0	58.8	0.0	-195.2	0.0	195.2	0.0	195.2

AASHTO Limit State: STR 1 - STRENGTH I

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 1/ 213	-0.8	0.0	8.7	0.0	-117.4	0.0	117.4	0.0	117.4
	Max Fy	STR 1/ 7	-131.3	0.2	-64.5	-6.3	-171.5	5.4	171.6	8.3	171.6
	Max Fz	STR 1/ 159	-6.0	0.0	9.3	0.0	-168.2	0.0	168.2	0.0	168.2
	Max Mx	STR 1/ 9	-96.4	0.0	-43.9	1.4	-175.4	-1.4	175.4	2.0	175.4
	Max My	STR 1/ 83	-140.5	0.0	-74.0	0.0	-109.1	0.0	109.1	0.0	109.1
Load No.	Max Mz	STR 1/ 8	-120.4	0.2	-58.0	-7.7	-170.5	6.8	170.6	10.3	170.6
3	Max Mxy	STR 1/ 120	-55.7	0.0	-19.5	0.0	-177.9	0.0	177.9	0.0	177.9
	Max Mxz	STR 1/ 8	-120.4	0.2	-58.0	-7.7	-170.5	6.8	170.6	10.3	170.6
Member	Max Myz	STR 1/ 120	-55.7	0.0	-19.5	0.0	-177.9	0.0	177.9	0.0	177.9
503	Min Fx	STR 1/ 1	-176.9	0.0	-91.5	0.0	-169.1	0.0	169.1	0.0	169.1
	Min Fy	STR 1/ 1	-176.9	0.0	-91.5	0.0	-169.1	0.0	169.1	0.0	169.1
Joint	Min Fz	STR 1/ 55	-171.7	0.0	-92.1	0.0	-118.3	0.0	118.3	0.0	118.3
116	Min Mx	STR 1/ 8	-120.4	0.2	-58.0	-7.7	-170.5	6.8	170.6	10.3	170.6
	Min My	STR 1/ 120	-55.7	0.0	-19.5	0.0	-177.9	0.0	177.9	0.0	177.9
	Min Mz	STR 1/ 9	-96.4	0.0	-43.9	1.4	-175.4	-1.4	175.4	2.0	175.4
	Min Mxy	STR 1/ 83	-140.5	0.0	-74.0	0.0	-109.1	0.0	109.1	0.0	109.1
	Min Mxz	STR 1/ 1	-176.9	0.0	-91.5	0.0	-169.1	0.0	169.1	0.0	169.1
	Min Myz	STR 1/ 83	-140.5	0.0	-74.0	0.0	-109.1	0.0	109.1	0.0	109.1
	Max Fx	STR 1/ 186	-55.2	0.0	-35.3	0.0	-58.5	0.0	58.5	0.0	58.5
	Max Fy	STR 1/ 7	-170.8	0.2	-120.7	-5.8	-78.8	4.0	79.0	7.0	78.9
	Max Fz	STR 1/ 186	-55.2	0.0	-35.3	0.0	-58.5	0.0	58.5	0.0	58.5
	Max Mx	STR 1/ 9	-130.8	0.0	-90.0	1.9	-82.1	-1.8	82.1	2.6	82.1
	Max My	STR 1/ 83	-223.7	0.0	-164.0	0.0	-43.6	0.0	43.6	0.0	43.6
Load No.	Max Mz	STR 1/ 8	-160.5	0.2	-112.8	-7.7	-77.5	5.8	77.9	9.6	77.7
4	Max Mxy	STR 1/ 120	-90.9	0.0	-59.5	0.0	-85.6	0.0	85.6	0.0	85.6
	Max Mxz	STR 1/ 8	-160.5	0.2	-112.8	-7.7	-77.5	5.8	77.9	9.6	77.7
Member	Max Myz	STR 1/ 120	-90.9	0.0	-59.5	0.0	-85.6	0.0	85.6	0.0	85.6
504	Min Fx	STR 1/ 28	-251.3	0.0	-182.2	0.0	-70.5	0.0	70.5	0.0	70.5
	Min Fy	STR 1/ 1	-221.2	0.0	-159.0	0.0	-76.7	0.0	76.7	0.0	76.7
Joint	Min Fz	STR 1/ 28	-251.3	0.0	-182.2	0.0	-70.5	0.0	70.5	0.0	70.5
121	Min Mx	STR 1/ 8	-160.5	0.2	-112.8	-7.7	-77.5	5.8	77.9	9.6	77.7
	Min My	STR 1/ 120	-90.9	0.0	-59.5	0.0	-85.6	0.0	85.6	0.0	85.6
	Min Mz	STR 1/ 9	-130.8	0.0	-90.0	1.9	-82.1	-1.8	82.1	2.6	82.1
	Min Mxy	STR 1/ 83	-223.7	0.0	-164.0	0.0	-43.6	0.0	43.6	0.0	43.6
	Min Mxz	STR 1/ 1	-221.2	0.0	-159.0	0.0	-76.7	0.0	76.7	0.0	76.7
	Min Myz	STR 1/ 83	-223.7	0.0	-164.0	0.0	-43.6	0.0	43.6	0.0	43.6

AASHTO Limit State: STR 1 - STRENGTH I

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
Load No. 5 **Member** 505 **Joint** 126	Max Fx	STR 1/ 186	-50.1	0.0	-59.1	0.0	-20.7	0.0	20.7	0.0	20.7
	Max Fy	STR 1/ 8	-172.7	0.2	-213.9	-4.4	-21.2	1.9	21.7	4.8	21.3
	Max Fz	STR 1/ 186	-50.1	0.0	-59.1	0.0	-20.7	0.0	20.7	0.0	20.7
	Max Mx	STR 1/ 9	-138.5	-0.2	-169.9	2.6	-24.7	-1.8	24.9	3.2	24.8
	Max My	STR 1/ 83	-254.5	0.0	-320.1	0.0	-7.8	0.0	7.8	0.0	7.8
	Max Mz	STR 1/ 8	-172.7	0.2	-213.9	-4.4	-21.2	1.9	21.7	4.8	21.3
	Max Mxy	STR 1/ 129	-62.4	0.0	-72.9	0.0	-31.0	0.0	31.0	0.0	31.0
	Max Mxz	STR 1/ 8	-172.7	0.2	-213.9	-4.4	-21.2	1.9	21.7	4.8	21.3
	Max Myz	STR 1/ 129	-62.4	0.0	-72.9	0.0	-31.0	0.0	31.0	0.0	31.0
	Min Fx	STR 1/ 28	-268.1	0.0	-335.5	0.0	-18.5	0.0	18.5	0.0	18.5
	Min Fy	STR 1/ 9	-138.5	-0.2	-169.9	2.6	-24.7	-1.8	24.9	3.2	24.8
	Min Fz	STR 1/ 28	-268.1	0.0	-335.5	0.0	-18.5	0.0	18.5	0.0	18.5
	Min Mx	STR 1/ 8	-172.7	0.2	-213.9	-4.4	-21.2	1.9	21.7	4.8	21.3
	Min My	STR 1/ 129	-62.4	0.0	-72.9	0.0	-31.0	0.0	31.0	0.0	31.0
	Min Mz	STR 1/ 9	-138.5	-0.2	-169.9	2.6	-24.7	-1.8	24.9	3.2	24.8
	Min Mxy	STR 1/ 83	-254.5	0.0	-320.1	0.0	-7.8	0.0	7.8	0.0	7.8
	Min Mxz	STR 1/ 1	-218.9	0.0	-272.5	0.0	-21.6	0.0	21.6	0.0	21.6
	Min Myz	STR 1/ 83	-254.5	0.0	-320.1	0.0	-7.8	0.0	7.8	0.0	7.8
Load No. 6 **Member** 601 **Joint** 156	Max Fx	STR 1/ 1	18.8	0.0	-1.4	0.0	166.2	0.0	166.2	0.0	166.2
	Max Fy	STR 1/ 1	18.8	0.0	-1.4	0.0	166.2	0.0	166.2	0.0	166.2
	Max Fz	STR 1/ 159	-336.9	0.0	279.4	0.0	150.7	0.0	150.7	0.0	150.7
	Max Mx	STR 1/ 8	-4.3	0.0	17.0	4.6	166.4	4.0	166.4	6.1	166.4
	Max My	STR 1/ 2	13.7	0.0	2.8	0.0	170.4	0.0	170.4	0.0	170.4
	Max Mz	STR 1/ 8	-4.3	0.0	17.0	4.6	166.4	4.0	166.4	6.1	166.4
	Max Mxy	STR 1/ 2	13.7	0.0	2.8	0.0	170.4	0.0	170.4	0.0	170.4
	Max Mxz	STR 1/ 8	-4.3	0.0	17.0	4.6	166.4	4.0	166.4	6.1	166.4
	Max Myz	STR 1/ 2	13.7	0.0	2.8	0.0	170.4	0.0	170.4	0.0	170.4
	Min Fx	STR 1/ 213	-341.1	0.0	279.0	0.0	103.6	0.0	103.6	0.0	103.6
	Min Fy	STR 1/ 1	18.8	0.0	-1.4	0.0	166.2	0.0	166.2	0.0	166.2
	Min Fz	STR 1/ 55	14.6	0.0	-1.8	0.0	119.0	0.0	119.0	0.0	119.0
	Min Mx	STR 1/ 9	-19.9	0.0	29.1	-3.7	160.3	-3.2	160.3	4.8	160.3
	Min My	STR 1/ 210	-336.7	0.0	275.5	0.0	99.7	0.0	99.7	0.0	99.7
	Min Mz	STR 1/ 9	-19.9	0.0	29.1	-3.7	160.3	-3.2	160.3	4.8	160.3
	Min Mxy	STR 1/ 210	-336.7	0.0	275.5	0.0	99.7	0.0	99.7	0.0	99.7
	Min Mxz	STR 1/ 1	18.8	0.0	-1.4	0.0	166.2	0.0	166.2	0.0	166.2
	Min Myz	STR 1/ 210	-336.7	0.0	275.5	0.0	99.7	0.0	99.7	0.0	99.7

AASHTO Limit State: STR 1 - STRENGTH I

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 1/ 1	96.0	0.0	-69.0	0.0	122.4	0.0	122.4	0.0	122.4
	Max Fy	STR 1/ 1	96.0	0.0	-69.0	0.0	122.4	0.0	122.4	0.0	122.4
	Max Fz	STR 1/ 213	-139.2	0.0	125.0	0.0	74.5	0.0	74.5	0.0	74.5
	Max Mx	STR 1/ 8	56.4	-0.2	-35.9	4.9	122.4	4.2	122.5	6.5	122.4
	Max My	STR 1/ 2	77.8	0.0	-53.6	0.0	127.5	0.0	127.5	0.0	127.5
Load No.	Max Mz	STR 1/ 8	56.4	-0.2	-35.9	4.9	122.4	4.2	122.5	6.5	122.4
7	Max Mxy	STR 1/ 2	77.8	0.0	-53.6	0.0	127.5	0.0	127.5	0.0	127.5
	Max Mxz	STR 1/ 8	56.4	-0.2	-35.9	4.9	122.4	4.2	122.5	6.5	122.4
Member	Max Myz	STR 1/ 2	77.8	0.0	-53.6	0.0	127.5	0.0	127.5	0.0	127.5
602	Min Fx	STR 1/ 213	-139.2	0.0	125.0	0.0	74.5	0.0	74.5	0.0	74.5
	Min Fy	STR 1/ 8	56.4	-0.2	-35.9	4.9	122.4	4.2	122.5	6.5	122.4
Joint	Min Fz	STR 1/ 1	96.0	0.0	-69.0	0.0	122.4	0.0	122.4	0.0	122.4
151	Min Mx	STR 1/ 9	44.2	0.0	-25.7	-2.8	114.9	-2.3	114.9	3.6	114.9
	Min My	STR 1/ 210	-123.3	0.0	111.3	0.0	70.1	0.0	70.1	0.0	70.1
	Min Mz	STR 1/ 9	44.2	0.0	-25.7	-2.8	114.9	-2.3	114.9	3.6	114.9
	Min Mxy	STR 1/ 210	-123.3	0.0	111.3	0.0	70.1	0.0	70.1	0.0	70.1
	Min Mxz	STR 1/ 1	96.0	0.0	-69.0	0.0	122.4	0.0	122.4	0.0	122.4
	Min Myz	STR 1/ 210	-123.3	0.0	111.3	0.0	70.1	0.0	70.1	0.0	70.1
	Max Fx	STR 1/ 1	149.8	0.0	-126.6	0.0	85.3	0.0	85.3	0.0	85.3
	Max Fy	STR 1/ 1	149.8	0.0	-126.6	0.0	85.3	0.0	85.3	0.0	85.3
	Max Fz	STR 1/ 213	-8.8	0.0	14.9	0.0	55.4	0.0	55.4	0.0	55.4
	Max Mx	STR 1/ 8	99.7	-0.2	-80.9	5.6	85.2	4.7	85.3	7.3	85.3
	Max My	STR 1/ 11	82.8	0.0	-65.3	0.0	91.2	0.0	91.2	0.0	91.2
Load No.	Max Mz	STR 1/ 8	99.7	-0.2	-80.9	5.6	85.2	4.7	85.3	7.3	85.3
8	Max Mxy	STR 1/ 11	82.8	0.0	-65.3	0.0	91.2	0.0	91.2	0.0	91.2
	Max Mxz	STR 1/ 8	99.7	-0.2	-80.9	5.6	85.2	4.7	85.3	7.3	85.3
Member	Max Myz	STR 1/ 11	82.8	0.0	-65.3	0.0	91.2	0.0	91.2	0.0	91.2
603	Min Fx	STR 1/ 213	-8.8	0.0	14.9	0.0	55.4	0.0	55.4	0.0	55.4
	Min Fy	STR 1/ 7	112.3	-0.2	-92.6	4.0	82.9	3.3	83.0	5.2	82.9
Joint	Min Fz	STR 1/ 1	149.8	0.0	-126.6	0.0	85.3	0.0	85.3	0.0	85.3
146	Min Mx	STR 1/ 9	87.7	0.0	-70.2	-1.6	78.2	-1.2	78.2	2.0	78.2
	Min My	STR 1/ 192	74.8	0.0	-61.6	0.0	50.6	0.0	50.6	0.0	50.6
	Min Mz	STR 1/ 9	87.7	0.0	-70.2	-1.6	78.2	-1.2	78.2	2.0	78.2
	Min Mxy	STR 1/ 192	74.8	0.0	-61.6	0.0	50.6	0.0	50.6	0.0	50.6
	Min Mxz	STR 1/ 1	149.8	0.0	-126.6	0.0	85.3	0.0	85.3	0.0	85.3
	Min Myz	STR 1/ 192	74.8	0.0	-61.6	0.0	50.6	0.0	50.6	0.0	50.6

AASHTO Limit State: STR 1 - STRENGTH I

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 1/ 28	212.0	0.0	-210.1	0.0	59.8	0.0	59.8	0.0	59.8
	Max Fy	STR 1/ 1	186.7	0.0	-184.1	0.0	57.3	0.0	57.3	0.0	57.3
	Max Fz	STR 1/ 186	39.8	0.0	-35.3	0.0	39.0	0.0	39.0	0.0	39.0
	Max Mx	STR 1/ 8	129.0	-0.2	-124.6	6.3	56.1	4.9	56.5	8.0	56.3
	Max My	STR 1/ 38	138.3	0.0	-133.8	0.0	66.0	0.0	66.0	0.0	66.0
Load No.	Max Mz	STR 1/ 8	129.0	-0.2	-124.6	6.3	56.1	4.9	56.5	8.0	56.3
9	Max Mxy	STR 1/ 38	138.3	0.0	-133.8	0.0	66.0	0.0	66.0	0.0	66.0
	Max Mxz	STR 1/ 8	129.0	-0.2	-124.6	6.3	56.1	4.9	56.5	8.0	56.3
Member	Max Myz	STR 1/ 38	138.3	0.0	-133.8	0.0	66.0	0.0	66.0	0.0	66.0
604	Min Fx	STR 1/ 186	39.8	0.0	-35.3	0.0	39.0	0.0	39.0	0.0	39.0
	Min Fy	STR 1/ 7	145.2	-0.2	-141.4	6.0	54.7	4.7	55.0	7.6	54.9
Joint	Min Fz	STR 1/ 28	212.0	0.0	-210.1	0.0	59.8	0.0	59.8	0.0	59.8
141	Min Mx	STR 1/ 9	120.0	0.0	-115.8	-0.4	50.3	-0.2	50.3	0.4	50.3
	Min My	STR 1/ 165	121.9	0.0	-119.9	0.0	33.4	0.0	33.4	0.0	33.4
	Min Mz	STR 1/ 9	120.0	0.0	-115.8	-0.4	50.3	-0.2	50.3	0.4	50.3
	Min Mxy	STR 1/ 165	121.9	0.0	-119.9	0.0	33.4	0.0	33.4	0.0	33.4
	Min Mxz	STR 1/ 1	186.7	0.0	-184.1	0.0	57.3	0.0	57.3	0.0	57.3
	Min Myz	STR 1/ 165	121.9	0.0	-119.9	0.0	33.4	0.0	33.4	0.0	33.4
	Max Fx	STR 1/ 28	209.2	0.0	-255.3	0.0	33.7	0.0	33.7	0.0	33.7
	Max Fy	STR 1/ 1	175.3	0.0	-212.9	0.0	32.1	0.0	32.1	0.0	32.1
	Max Fz	STR 1/ 186	40.4	0.0	-46.1	0.0	21.6	0.0	21.6	0.0	21.6
	Max Mx	STR 1/ 7	141.7	-0.2	-171.1	6.7	29.1	4.7	29.9	8.2	29.5
	Max My	STR 1/ 47	120.9	0.0	-144.4	0.0	40.6	0.0	40.6	0.0	40.6
Load No.	Max Mz	STR 1/ 7	141.7	-0.2	-171.1	6.7	29.1	4.7	29.9	8.2	29.5
10	Max Mxy	STR 1/ 47	120.9	0.0	-144.4	0.0	40.6	0.0	40.6	0.0	40.6
	Max Mxz	STR 1/ 7	141.7	-0.2	-171.1	6.7	29.1	4.7	29.9	8.2	29.5
Member	Max Myz	STR 1/ 47	120.9	0.0	-144.4	0.0	40.6	0.0	40.6	0.0	40.6
605	Min Fx	STR 1/ 186	40.4	0.0	-46.1	0.0	21.6	0.0	21.6	0.0	21.6
	Min Fy	STR 1/ 7	141.7	-0.2	-171.1	6.7	29.1	4.7	29.9	8.2	29.5
Joint	Min Fz	STR 1/ 28	209.2	0.0	-255.3	0.0	33.7	0.0	33.7	0.0	33.7
136	Min Mx	STR 1/ 1	175.3	0.0	-212.9	0.0	32.1	0.0	32.1	0.0	32.1
	Min My	STR 1/ 165	124.8	0.0	-152.1	0.0	16.0	0.0	16.0	0.0	16.0
	Min Mz	STR 1/ 1	175.3	0.0	-212.9	0.0	32.1	0.0	32.1	0.0	32.1
	Min Mxy	STR 1/ 165	124.8	0.0	-152.1	0.0	16.0	0.0	16.0	0.0	16.0
	Min Mxz	STR 1/ 1	175.3	0.0	-212.9	0.0	32.1	0.0	32.1	0.0	32.1
	Min Myz	STR 1/ 165	124.8	0.0	-152.1	0.0	16.0	0.0	16.0	0.0	16.0

Limit State: STRENGTH I

FR Friction
LF: 1
FR1: CR+SH+PT_EOC
FR2: CR+SH+PT_D10K

TU Uniform Temperature
LF: 0.5
TU1: TU-
TU2: TU+
TU3: TU+Temp. Diff.

DW DL Wearing Surfaces & Utilities
LF1: 1.5
LF2: 0.65
DW1: DW

LL Vehicular Live Load
LF: 1.75
LL1: LL1_Deck
LL2: LL2_Deck
LL3: LL3_Deck
LL4: LL1_Roof
LL5: LL2_Roof
LL6: LL3_Roof
LL7: LL1_Deck Offset
LL8: LL2_Deck Offset
LL9: LL3_Deck Offset

DC DL Structural Components & Attachments
LF1: 1.25
LF2: 0.9
DC1: DC

Combo ID	Load Combinations
STR 1/ 1	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU1*0.50 + LL1*1.75)
STR 1/ 2	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU1*0.50 + LL2*1.75)
STR 1/ 3	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU1*0.50 + LL3*1.75)
STR 1/ 4	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU1*0.50 + LL4*1.75)
STR 1/ 5	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU1*0.50 + LL5*1.75)
STR 1/ 6	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU1*0.50 + LL6*1.75)
STR 1/ 7	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU1*0.50 + LL7*1.75)
STR 1/ 8	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU1*0.50 + LL8*1.75)
STR 1/ 9	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU1*0.50 + LL9*1.75)
STR 1/ 10	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU2*0.50 + LL1*1.75)
STR 1/ 11	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU2*0.50 + LL2*1.75)
STR 1/ 12	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU2*0.50 + LL3*1.75)
STR 1/ 13	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU2*0.50 + LL4*1.75)
STR 1/ 14	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU2*0.50 + LL5*1.75)
STR 1/ 15	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU2*0.50 + LL6*1.75)
STR 1/ 16	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU2*0.50 + LL7*1.75)
STR 1/ 17	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU2*0.50 + LL8*1.75)
STR 1/ 18	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU2*0.50 + LL9*1.75)
STR 1/ 19	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU3*0.50 + LL1*1.75)
STR 1/ 20	1.00*(DW1*1.50 + DC1*1.25 + FR1*1.00 + TU3*0.50 + LL2*1.75)

Limit State: STRENGTH I

FR Friction
LF: 1
FR1: CR+SH+PT_EOC
FR2: CR+SH+PT_D10K

TU Uniform Temperature
LF: 0.5
TU1: TU-
TU2: TU+
TU3: TU+Temp. Diff.

DW DL Wearing Surfaces & Utilities
LF1: 1.5
LF2: 0.65
DW1: DW

LL Vehicular Live Load
LF: 1.75
LL1: LL1_Deck
LL2: LL2_Deck
LL3: LL3_Deck
LL4: LL1_Roof
LL5: LL2_Roof
LL6: LL3_Roof
LL7: LL1_Deck Offset
LL8: LL2_Deck Offset
LL9: LL3_Deck Offset

DC DL Structural Components & Attachments
LF1: 1.25
LF2: 0.9
DC1: DC

Load (Row) Number	User's Load ID	Member ID	Joint ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)
1	CR+SH+PT_D10K	501	106	296.8	0	134.7	0	17.5	0
2	CR+SH+PT_D10K	502	111	97.2	0	48.8	0	16.5	0
3	CR+SH+PT_D10K	503	116	-16.4	0	-10	0	12.5	0
4	CR+SH+PT_D10K	504	121	-83.6	0	-64.1	0	10.8	0
5	CR+SH+PT_D10K	505	126	-110.9	0	-141.7	0	5.7	0
6	CR+SH+PT_D10K	601	156	-270.4	0	213.4	0	-16	0
7	CR+SH+PT_D10K	602	151	-101.1	0	84.6	0	-12.2	0
8	CR+SH+PT_D10K	603	146	10.1	0	-9.4	0	-4.7	0
9	CR+SH+PT_D10K	604	141	76.2	0	-78.4	0	2.3	0
10	CR+SH+PT_D10K	605	136	90.3	0	-113	0	0.3	0
1	CR+SH+PT_EOC	501	106	99.3	0	45.1	0	7.8	0
2	CR+SH+PT_EOC	502	111	20.6	0	10.3	0	7.1	0
3	CR+SH+PT_EOC	503	116	-25.7	0	-15.3	0	5.5	0
4	CR+SH+PT_EOC	504	121	-53.5	0	-40.9	0	4.6	0
5	CR+SH+PT_EOC	505	126	-61.7	0	-78.7	0	2.6	0
6	CR+SH+PT_EOC	601	156	-86.5	0	68.2	0	-7.5	0
7	CR+SH+PT_EOC	602	151	-23.7	0	19.7	0	-6.3	0
8	CR+SH+PT_EOC	603	146	21.4	0	-19.6	0	-3.6	0
9	CR+SH+PT_EOC	604	141	50.9	0	-52.4	0	-0.2	0
10	CR+SH+PT_EOC	605	136	56.4	0	-70.6	0	-1.3	0

Load (Row) Number	User's Load ID	Member ID	Joint ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)
1	DC	501	106	4.3	0	18.8	0	-379.4	0
2	DC	502	111	-6.3	0	10.5	0	-248.4	0
3	DC	503	116	-14.9	0	1.9	0	-145	0
4	DC	504	121	-19.9	0	-7.4	0	-69.8	0
5	DC	505	126	-16.2	0	-15.5	0	-23	0
6	DC	601	156	12	0	1.3	0	134.8	0
7	DC	602	151	13.6	0	-2.1	0	97.9	0
8	DC	603	146	12.1	0	-3.2	0	66.7	0
9	DC	604	141	10.2	0	-4.2	0	41.8	0
10	DC	605	136	6.6	0	-3.4	0	22.7	0
1	DW	501	106	-1.4	0	-0.7	0	0.7	0
2	DW	502	111	-10	0	-5.1	0	1.1	0
3	DW	503	116	-14.3	0	-8.5	0	0.8	0
4	DW	504	121	-15.8	0	-12	0	0.6	0
5	DW	505	126	-13.2	0	-16.8	0	0.3	0
6	DW	601	156	6.5	0	-5.1	0	0.6	0
7	DW	602	151	9.5	0	-8	0	0.8	0
8	DW	603	146	11.7	0	-10.6	0	0.8	0
9	DW	604	141	13	0	-13.3	0	0.9	0
10	DW	605	136	10.5	0	-13.1	0	1	0
1	LL1_Deck	501	106	-5.1	0	-2.4	0	2.6	0
2	LL1_Deck	502	111	-36.4	0	-18.5	0	4	0
3	LL1_Deck	503	116	-52.2	0	-30.9	0	2.9	0
4	LL1_Deck	504	121	-57.6	0	-43.9	0	2.4	0
5	LL1_Deck	505	126	-48.2	0	-61.4	0	1.1	0
6	LL1_Deck	601	156	23.6	0	-18.6	0	2.2	0
7	LL1_Deck	602	151	34.8	0	-29.1	0	2.8	0
8	LL1_Deck	603	146	42.8	0	-38.9	0	2.8	0
9	LL1_Deck	604	141	47.4	0	-48.7	0	3.1	0
10	LL1_Deck	605	136	38.4	0	-47.8	0	3.5	0
1	LL1_Deck Offset	501	106	-2.5	0.1	-1.2	-4.3	1.3	4.1
2	LL1_Deck Offset	502	111	-18.2	0.1	-9.2	-4	2	3.8
3	LL1_Deck Offset	503	116	-26.1	0.1	-15.5	-3.6	1.5	3.1
4	LL1_Deck Offset	504	121	-28.8	0.1	-22	-3.3	1.2	2.3
5	LL1_Deck Offset	505	126	-24.1	0	-30.7	-1.1	0.6	0.2
6	LL1_Deck Offset	601	156	11.8	0	-9.3	0.5	1.1	0.5
7	LL1_Deck Offset	602	151	17.4	0	-14.5	1.2	1.4	1.1
8	LL1_Deck Offset	603	146	21.4	-0.1	-19.5	2.3	1.4	1.9
9	LL1_Deck Offset	604	141	23.7	-0.1	-24.3	3.4	1.6	2.7
10	LL1_Deck Offset	605	136	19.2	-0.1	-23.9	3.8	1.8	2.7
1	LL1_Roof	501	106	-1.2	0	-0.5	0	-2.1	0
2	LL1_Roof	502	111	-4.1	0	-2.1	0	1	0
3	LL1_Roof	503	116	-5.9	0	-3.5	0	0.3	0
4	LL1_Roof	504	121	-6.9	0	-5.3	0	0.4	0
5	LL1_Roof	505	126	-6.2	0	-7.9	0	0.1	0
6	LL1_Roof	601	156	3.2	0	-2.5	0	0.4	0
7	LL1_Roof	602	151	4.2	0	-3.6	0	0.3	0
8	LL1_Roof	603	146	5.1	0	-4.6	0	0.4	0
9	LL1_Roof	604	141	5.2	0	-5.4	0	0.4	0
10	LL1_Roof	605	136	5.1	0	-6.3	0	-0.1	0
1	LL2_Deck	501	106	6.7	0	3	0	3.5	0
2	LL2_Deck	502	111	-24.7	0	-12.6	0	5.3	0
3	LL2_Deck	503	116	-39.7	0	-23.6	0	4.2	0
4	LL2_Deck	504	121	-45.8	0	-35	0	3.8	0
5	LL2_Deck	505	126	-43.7	0	-55.7	0	2.6	0
6	LL2_Deck	601	156	20.7	0	-16.2	0	4.6	0
7	LL2_Deck	602	151	24.4	0	-20.3	0	5.7	0
8	LL2_Deck	603	146	28.3	0	-25.6	0	5.5	0
9	LL2_Deck	604	141	28.8	0	-29.4	0	4.9	0
10	LL2_Deck	605	136	22.4	0	-27.7	0	4.2	0

Load (Row) Number	User's Load ID	Member ID	Joint ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)
1	LL2_Deck Offset	501	106	3.4	0.1	1.5	-4.7	1.8	4.5
2	LL2_Deck Offset	502	111	-12.3	0.1	-6.3	-4.6	2.7	4.4
3	LL2_Deck Offset	503	116	-19.9	0.1	-11.8	-4.4	2.1	3.9
4	LL2_Deck Offset	504	121	-22.9	0.1	-17.5	-4.4	1.9	3.3
5	LL2_Deck Offset	505	126	-21.8	0.1	-27.9	-2.5	1.3	1.1
6	LL2_Deck Offset	601	156	10.4	0	-8.1	2.6	2.3	2.3
7	LL2_Deck Offset	602	151	12.2	-0.1	-10.2	2.8	2.8	2.4
8	LL2_Deck Offset	603	146	14.2	-0.1	-12.8	3.2	2.7	2.7
9	LL2_Deck Offset	604	141	14.4	-0.1	-14.7	3.6	2.4	2.8
10	LL2_Deck Offset	605	136	11.2	-0.1	-13.9	3.8	2.1	2.6
1	LL2_Roof	501	106	0.2	0	0.1	0	-2	0
2	LL2_Roof	502	111	-2.8	0	-1.4	0	1.1	0
3	LL2_Roof	503	116	-4.5	0	-2.6	0	0.4	0
4	LL2_Roof	504	121	-5.5	0	-4.2	0	0.5	0
5	LL2_Roof	505	126	-5.5	0	-7	0	0.3	0
6	LL2_Roof	601	156	2.7	0	-2.1	0	0.6	0
7	LL2_Roof	602	151	3	0	-2.5	0	0.7	0
8	LL2_Roof	603	146	3.4	0	-3.1	0	0.7	0
9	LL2_Roof	604	141	3.5	0	-3.6	0	0.6	0
10	LL2_Roof	605	136	2.8	0	-3.5	0	0.5	0
1	LL3_Deck	501	106	-11.8	0	-5.4	0	-0.9	0
2	LL3_Deck	502	111	-11.7	0	-5.9	0	-1.3	0
3	LL3_Deck	503	116	-12.5	0	-7.3	0	-1.3	0
4	LL3_Deck	504	121	-11.8	0	-8.9	0	-1.4	0
5	LL3_Deck	505	126	-4.5	0	-5.6	0	-1.5	0
6	LL3_Deck	601	156	3	0	-2.4	0	-2.4	0
7	LL3_Deck	602	151	10.3	0	-8.8	0	-2.9	0
8	LL3_Deck	603	146	14.5	0	-13.4	0	-2.7	0
9	LL3_Deck	604	141	18.7	0	-19.3	0	-1.8	0
10	LL3_Deck	605	136	16	0	-20.1	0	-0.7	0
1	LL3_Deck Offset	501	106	-5.9	0	-2.7	0.5	-0.5	-0.4
2	LL3_Deck Offset	502	111	-5.9	0	-2.9	0.6	-0.7	-0.6
3	LL3_Deck Offset	503	116	-6.2	0	-3.7	0.8	-0.7	-0.8
4	LL3_Deck Offset	504	121	-5.9	0	-4.5	1.1	-0.7	-1
5	LL3_Deck Offset	505	126	-2.3	-0.1	-2.8	1.5	-0.7	-1
6	LL3_Deck Offset	601	156	1.5	0	-1.2	-2.1	-1.2	-1.8
7	LL3_Deck Offset	602	151	5.2	0	-4.4	-1.6	-1.5	-1.3
8	LL3_Deck Offset	603	146	7.3	0	-6.7	-0.9	-1.3	-0.7
9	LL3_Deck Offset	604	141	9.3	0	-9.7	-0.2	-0.9	-0.1
10	LL3_Deck Offset	605	136	8	0	-10.1	0	-0.3	0.1
1	LL3_Roof	501	106	-1.4	0	-0.6	0	-0.1	0
2	LL3_Roof	502	111	-1.3	0	-0.7	0	-0.1	0
3	LL3_Roof	503	116	-1.4	0	-0.9	0	-0.1	0
4	LL3_Roof	504	121	-1.4	0	-1.1	0	-0.2	0
5	LL3_Roof	505	126	-0.7	0	-0.8	0	-0.2	0
6	LL3_Roof	601	156	0.5	0	-0.4	0	-0.2	0
7	LL3_Roof	602	151	1.2	0	-1	0	-0.4	0
8	LL3_Roof	603	146	1.6	0	-1.5	0	-0.3	0
9	LL3_Roof	604	141	1.7	0	-1.8	0	-0.2	0
10	LL3_Roof	605	136	2.2	0	-2.8	0	-0.7	0
1	TU-	501	106	-78.1	0	-35.5	0	0	0
2	TU-	502	111	-54.9	0	-27.8	0	-0.2	0
3	TU-	503	116	-39.6	0	-23.4	0	0.8	0
4	TU-	504	121	-36.7	0	-28	0	1.8	0
5	TU-	505	126	-65.5	0	-83.5	0	4.4	0
6	TU-	601	156	78.5	0	-62	0	0.9	0
7	TU-	602	151	55	0	-46.2	0	0.4	0
8	TU-	603	146	41.6	0	-38	0	-1.1	0
9	TU-	604	141	41.2	0	-42.5	0	-3	0
10	TU-	605	136	55.3	0	-69.5	0	-5.2	0

Load (Row) Number	User's Load ID	Member ID	Joint ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)
1	TU+	501	106	78.1	0	35.5	0	0	0
2	TU+	502	111	54.9	0	27.8	0	0.2	0
3	TU+	503	116	39.6	0	23.4	0	-0.8	0
4	TU+	504	121	36.7	0	28	0	-1.8	0
5	TU+	505	126	65.5	0	83.5	0	-4.4	0
6	TU+	601	156	-78.5	0	62	0	-0.9	0
7	TU+	602	151	-55	0	46.2	0	-0.4	0
8	TU+	603	146	-41.6	0	38	0	1.1	0
9	TU+	604	141	-41.2	0	42.5	0	3	0
10	TU+	605	136	-55.3	0	69.5	0	5.2	0
1	TU+Temp. Diff.	501	106	171.7	0	78	0	1.2	0
2	TU+Temp. Diff.	502	111	119.7	0	60.5	0	1.8	0
3	TU+Temp. Diff.	503	116	81.5	0	48.1	0	0.5	0
4	TU+Temp. Diff.	504	121	57.8	0	44	0	-0.6	0
5	TU+Temp. Diff.	505	126	72	0	91.8	0	-4.8	0
6	TU+Temp. Diff.	601	156	-173.2	0	136.8	0	-3.6	0
7	TU+Temp. Diff.	602	151	-117.3	0	98.4	0	-2.5	0
8	TU+Temp. Diff.	603	146	-80.3	0	73.3	0	0.2	0
9	TU+Temp. Diff.	604	141	-63.4	0	65.3	0	2.7	0
10	TU+Temp. Diff.	605	136	-65.3	0	82	0	6.1	0

AASHTO Limit State: STR 3 - STRENGTH III

Max/ Min ID	Load Num	Member Num	Joint Num	Limit State/ Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
Max Fx	1	501	106	STR 3/ 119	402.9	-5.0	200.0	52.6	-363.7	-114.8	367.5	126.3	381.4
Max Fy	5	505	126	STR 3/ 5	-133.0	-1.7	-159.6	19.9	-39.7	-10.2	44.4	22.4	41.0
Max Fz	6	601	156	STR 3/ 120	-350.0	-6.7	289.8	79.5	149.8	92.7	169.6	122.1	176.2
Max Mx	1	501	106	STR 3/ 1	63.5	-10.2	49.8	104.3	-465.4	-230.3	476.9	252.8	519.3
Max My	6	601	156	STR 3/ 9	-15.2	-3.4	29.9	39.8	221.3	46.1	224.8	60.8	226.0
Max Mz	6	601	156	STR 3/ 1	-22.5	-6.7	31.2	80.6	162.4	93.4	181.3	123.4	187.3
Max Mxy	1	501	106	STR 3/ 65	48.9	-5.0	47.3	52.6	-558.0	-114.8	560.5	126.3	569.7
Max Mxz	1	501	106	STR 3/ 1	63.5	-10.2	49.8	104.3	-465.4	-230.3	476.9	252.8	519.3
Max Myz	1	501	106	STR 3/ 65	48.9	-5.0	47.3	52.6	-558.0	-114.8	560.5	126.3	569.7
Min Fx	6	601	156	STR 3/ 240	-354.2	-6.7	289.3	79.5	102.7	92.7	129.8	122.1	138.3
Min Fy	1	501	106	STR 3/ 1	63.5	-10.2	49.8	104.3	-465.4	-230.3	476.9	252.8	519.3
Min Fz	5	505	126	STR 3/ 39	-185.2	-1.7	-233.5	19.9	-4.2	-10.2	20.3	22.4	11.0
Min Mx	5	505	126	STR 3/ 5	-133.0	-1.7	-159.6	19.9	-39.7	-10.2	44.4	22.4	41.0
Min My	1	501	106	STR 3/ 65	48.9	-5.0	47.3	52.6	-558.0	-114.8	560.5	126.3	569.7
Min Mz	1	501	106	STR 3/ 1	63.5	-10.2	49.8	104.3	-465.4	-230.3	476.9	252.8	519.3
Min Mxy	5	505	126	STR 3/ 169	-114.1	-1.7	-144.6	19.9	-0.5	-10.2	19.9	22.4	10.2
Min Mxz	5	505	126	STR 3/ 5	-133.0	-1.7	-159.6	19.9	-39.7	-10.2	44.4	22.4	41.0
Min Myz	5	505	126	STR 3/ 169	-114.1	-1.7	-144.6	19.9	-0.5	-10.2	19.9	22.4	10.2

AASHTO Limit State: STR 3 - STRENGTH III

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 3/ 119	402.9	-5.0	200.0	52.6	-363.7	-114.8	367.5	126.3	381.4
	Max Fy	STR 3/ 5	47.7	-5.0	46.7	52.6	-557.4	-114.8	559.9	126.3	569.1
	Max Fz	STR 3/ 119	402.9	-5.0	200.0	52.6	-363.7	-114.8	367.5	126.3	381.4
	Max Mx	STR 3/ 1	63.5	-10.2	49.8	104.3	-465.4	-230.3	476.9	252.8	519.3
	Max My	STR 3/ 179	400.2	-5.0	192.8	52.6	-230.3	-114.8	236.3	126.3	257.4
Load No.	Max Mz	STR 3/ 5	47.7	-5.0	46.7	52.6	-557.4	-114.8	559.9	126.3	569.1
1	Max Mxy	STR 3/ 65	48.9	-5.0	47.3	52.6	-558.0	-114.8	560.5	126.3	569.7
	Max Mxz	STR 3/ 1	63.5	-10.2	49.8	104.3	-465.4	-230.3	476.9	252.8	519.3
Member	Max Myz	STR 3/ 65	48.9	-5.0	47.3	52.6	-558.0	-114.8	560.5	126.3	569.7
501	Min Fx	STR 3/ 125	46.2	-5.0	40.1	52.6	-424.6	-114.8	427.8	126.3	439.8
	Min Fy	STR 3/ 1	63.5	-10.2	49.8	104.3	-465.4	-230.3	476.9	252.8	519.3
Joint	Min Fz	STR 3/ 125	46.2	-5.0	40.1	52.6	-424.6	-114.8	427.8	126.3	439.8
106	Min Mx	STR 3/ 5	47.7	-5.0	46.7	52.6	-557.4	-114.8	559.9	126.3	569.1
	Min My	STR 3/ 65	48.9	-5.0	47.3	52.6	-558.0	-114.8	560.5	126.3	569.7
	Min Mz	STR 3/ 1	63.5	-10.2	49.8	104.3	-465.4	-230.3	476.9	252.8	519.3
	Min Mxy	STR 3/ 179	400.2	-5.0	192.8	52.6	-230.3	-114.8	236.3	126.3	257.4
	Min Mxz	STR 3/ 5	47.7	-5.0	46.7	52.6	-557.4	-114.8	559.9	126.3	569.1
	Min Myz	STR 3/ 179	400.2	-5.0	192.8	52.6	-230.3	-114.8	236.3	126.3	257.4
	Max Fx	STR 3/ 240	162.7	-8.3	94.1	70.4	-208.1	-144.5	219.7	160.7	253.3
	Max Fy	STR 3/ 5	-45.7	-4.2	-2.5	39.1	-369.9	-75.3	371.9	84.8	377.5
	Max Fz	STR 3/ 120	160.5	-8.3	97.8	70.4	-295.0	-144.5	303.3	160.7	328.5
	Max Mx	STR 3/ 1	-29.7	-8.4	1.9	76.9	-301.9	-150.4	311.5	168.9	337.2
	Max My	STR 3/ 179	152.3	-4.2	85.2	39.1	-136.5	-75.3	141.9	84.8	155.9
Load No.	Max Mz	STR 3/ 5	-45.7	-4.2	-2.5	39.1	-369.9	-75.3	371.9	84.8	377.5
2	Max Mxy	STR 3/ 65	-37.2	-4.2	1.9	39.1	-370.8	-75.3	372.9	84.8	378.4
	Max Mxz	STR 3/ 1	-29.7	-8.4	1.9	76.9	-301.9	-150.4	311.5	168.9	337.2
Member	Max Myz	STR 3/ 65	-37.2	-4.2	1.9	39.1	-370.8	-75.3	372.9	84.8	378.4
502	Min Fx	STR 3/ 5	-45.7	-4.2	-2.5	39.1	-369.9	-75.3	371.9	84.8	377.5
	Min Fy	STR 3/ 1	-29.7	-8.4	1.9	76.9	-301.9	-150.4	311.5	168.9	337.2
Joint	Min Fz	STR 3/ 125	-43.5	-4.2	-6.1	39.1	-283.0	-75.3	285.6	84.8	292.8
111	Min Mx	STR 3/ 5	-45.7	-4.2	-2.5	39.1	-369.9	-75.3	371.9	84.8	377.5
	Min My	STR 3/ 65	-37.2	-4.2	1.9	39.1	-370.8	-75.3	372.9	84.8	378.4
	Min Mz	STR 3/ 1	-29.7	-8.4	1.9	76.9	-301.9	-150.4	311.5	168.9	337.2
	Min Mxy	STR 3/ 179	152.3	-4.2	85.2	39.1	-136.5	-75.3	141.9	84.8	155.9
	Min Mxz	STR 3/ 5	-45.7	-4.2	-2.5	39.1	-369.9	-75.3	371.9	84.8	377.5
	Min Myz	STR 3/ 179	152.3	-4.2	85.2	39.1	-136.5	-75.3	141.9	84.8	155.9

Sum-It: AASHTO LRFD Load Combination Generator
Figg Bridge Engineers, Inc.
Limit State Results
File Name: Canopy Anchor Forces_Global.sum

AASHTO Limit State: STR 3 - STRENGTH III

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 3/ 240	27.0	-6.4	25.2	49.3	-118.6	-83.4	128.5	96.9	145.0
	Max Fy	STR 3/ 5	-100.0	-3.2	-42.6	28.6	-221.1	-44.8	222.9	53.1	225.5
	Max Fz	STR 3/ 120	21.8	-6.4	25.9	49.3	-169.4	-83.4	176.4	96.9	188.8
	Max Mx	STR 3/ 1	-85.6	-6.6	-37.4	55.7	-174.2	-89.0	182.8	105.0	195.6
	Max My	STR 3/ 159	-56.6	-3.2	-27.6	28.6	-69.5	-44.8	75.1	53.1	82.7
Load No.	Max Mz	STR 3/ 5	-100.0	-3.2	-42.6	28.6	-221.1	-44.8	222.9	53.1	225.5
3	Max Mxy	STR 3/ 75	-48.2	-3.2	-11.9	28.6	-222.5	-44.8	224.4	53.1	227.0
	Max Mxz	STR 3/ 1	-85.6	-6.6	-37.4	55.7	-174.2	-89.0	182.8	105.0	195.6
Member	Max Myz	STR 3/ 75	-48.2	-3.2	-11.9	28.6	-222.5	-44.8	224.4	53.1	227.0
503	Min Fx	STR 3/ 5	-100.0	-3.2	-42.6	28.6	-221.1	-44.8	222.9	53.1	225.5
	Min Fy	STR 3/ 1	-85.6	-6.6	-37.4	55.7	-174.2	-89.0	182.8	105.0	195.6
Joint	Min Fz	STR 3/ 125	-94.8	-3.2	-43.2	28.6	-170.3	-44.8	172.7	53.1	176.1
116	Min Mx	STR 3/ 5	-100.0	-3.2	-42.6	28.6	-221.1	-44.8	222.9	53.1	225.5
	Min My	STR 3/ 75	-48.2	-3.2	-11.9	28.6	-222.5	-44.8	224.4	53.1	227.0
	Min Mz	STR 3/ 1	-85.6	-6.6	-37.4	55.7	-174.2	-89.0	182.8	105.0	195.6
	Min Mxy	STR 3/ 159	-56.6	-3.2	-27.6	28.6	-69.5	-44.8	75.1	53.1	82.7
	Min Mxz	STR 3/ 5	-100.0	-3.2	-42.6	28.6	-221.1	-44.8	222.9	53.1	225.5
	Min Myz	STR 3/ 159	-56.6	-3.2	-27.6	28.6	-69.5	-44.8	75.1	53.1	82.7
	Max Fx	STR 3/ 210	-24.1	-4.6	-11.5	34.2	-59.4	-40.3	68.5	52.8	71.8
	Max Fy	STR 3/ 5	-129.9	-2.4	-86.2	21.4	-110.5	-23.2	112.6	31.6	112.9
	Max Fz	STR 3/ 210	-24.1	-4.6	-11.5	34.2	-59.4	-40.3	68.5	52.8	71.8
	Max Mx	STR 3/ 1	-120.4	-4.8	-82.2	41.7	-80.9	-45.9	91.0	62.0	93.0
	Max My	STR 3/ 159	-134.0	-2.4	-98.7	21.4	-20.5	-23.2	29.7	31.6	31.0
Load No.	Max Mz	STR 3/ 5	-129.9	-2.4	-86.2	21.4	-110.5	-23.2	112.6	31.6	112.9
4	Max Mxy	STR 3/ 75	-79.8	-2.4	-48.0	21.4	-112.8	-23.2	114.9	31.6	115.2
	Max Mxz	STR 3/ 1	-120.4	-4.8	-82.2	41.7	-80.9	-45.9	91.0	62.0	93.0
Member	Max Myz	STR 3/ 75	-79.8	-2.4	-48.0	21.4	-112.8	-23.2	114.9	31.6	115.2
504	Min Fx	STR 3/ 35	-160.0	-2.4	-109.4	21.4	-104.3	-23.2	106.5	31.6	106.9
	Min Fy	STR 3/ 1	-120.4	-4.8	-82.2	41.7	-80.9	-45.9	91.0	62.0	93.0
Joint	Min Fz	STR 3/ 35	-160.0	-2.4	-109.4	21.4	-104.3	-23.2	106.5	31.6	106.9
121	Min Mx	STR 3/ 5	-129.9	-2.4	-86.2	21.4	-110.5	-23.2	112.6	31.6	112.9
	Min My	STR 3/ 75	-79.8	-2.4	-48.0	21.4	-112.8	-23.2	114.9	31.6	115.2
	Min Mz	STR 3/ 1	-120.4	-4.8	-82.2	41.7	-80.9	-45.9	91.0	62.0	93.0
	Min Mxy	STR 3/ 159	-134.0	-2.4	-98.7	21.4	-20.5	-23.2	29.7	31.6	31.0
	Min Mxz	STR 3/ 5	-129.9	-2.4	-86.2	21.4	-110.5	-23.2	112.6	31.6	112.9
	Min Myz	STR 3/ 159	-134.0	-2.4	-98.7	21.4	-20.5	-23.2	29.7	31.6	31.0

AASHTO Limit State: STR 3 - STRENGTH III

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 3/ 210	-24.4	-3.2	-26.5	31.1	-20.9	-16.1	37.4	35.0	26.4
	Max Fy	STR 3/ 5	-133.0	-1.7	-159.6	19.9	-39.7	-10.2	44.4	22.4	41.0
	Max Fz	STR 3/ 210	-24.4	-3.2	-26.5	31.1	-20.9	-16.1	37.4	35.0	26.4
	Max Mx	STR 3/ 1	-134.5	-3.5	-165.0	39.1	-23.5	-20.3	45.6	44.0	31.1
	Max My	STR 3/ 159	-179.6	-1.7	-228.1	19.9	3.9	-10.2	20.3	22.4	10.9
Load No.	Max Mz	STR 3/ 5	-133.0	-1.7	-159.6	19.9	-39.7	-10.2	44.4	22.4	41.0
5	Max Mxy	STR 3/ 83	-53.7	-3.1	-60.2	34.2	-37.6	-17.6	50.8	38.4	41.5
	Max Mxz	STR 3/ 1	-134.5	-3.5	-165.0	39.1	-23.5	-20.3	45.6	44.0	31.1
Member	Max Myz	STR 3/ 85	-53.0	-1.7	-57.6	19.9	-44.6	-10.2	48.8	22.4	45.8
505	Min Fx	STR 3/ 39	-185.2	-1.7	-233.5	19.9	-4.2	-10.2	20.3	22.4	11.0
	Min Fy	STR 3/ 1	-134.5	-3.5	-165.0	39.1	-23.5	-20.3	45.6	44.0	31.1
Joint	Min Fz	STR 3/ 39	-185.2	-1.7	-233.5	19.9	-4.2	-10.2	20.3	22.4	11.0
126	Min Mx	STR 3/ 5	-133.0	-1.7	-159.6	19.9	-39.7	-10.2	44.4	22.4	41.0
	Min My	STR 3/ 85	-53.0	-1.7	-57.6	19.9	-44.6	-10.2	48.8	22.4	45.8
	Min Mz	STR 3/ 1	-134.5	-3.5	-165.0	39.1	-23.5	-20.3	45.6	44.0	31.1
	Min Mxy	STR 3/ 169	-114.1	-1.7	-144.6	19.9	-0.5	-10.2	19.9	22.4	10.2
	Min Mxz	STR 3/ 5	-133.0	-1.7	-159.6	19.9	-39.7	-10.2	44.4	22.4	41.0
	Min Myz	STR 3/ 169	-114.1	-1.7	-144.6	19.9	-0.5	-10.2	19.9	22.4	10.2
	Max Fx	STR 3/ 9	-15.2	-3.4	29.9	39.8	221.3	46.1	224.8	60.8	226.0
	Max Fy	STR 3/ 5	-29.9	-3.4	32.4	39.8	103.4	46.1	110.8	60.8	113.2
	Max Fz	STR 3/ 120	-350.0	-6.7	289.8	79.5	149.8	92.7	169.6	122.1	176.2
	Max Mx	STR 3/ 1	-22.5	-6.7	31.2	80.6	162.4	93.4	181.3	123.4	187.3
	Max My	STR 3/ 9	-15.2	-3.4	29.9	39.8	221.3	46.1	224.8	60.8	226.0
Load No.	Max Mz	STR 3/ 1	-22.5	-6.7	31.2	80.6	162.4	93.4	181.3	123.4	187.3
6	Max Mxy	STR 3/ 9	-15.2	-3.4	29.9	39.8	221.3	46.1	224.8	60.8	226.0
	Max Mxz	STR 3/ 1	-22.5	-6.7	31.2	80.6	162.4	93.4	181.3	123.4	187.3
Member	Max Myz	STR 3/ 9	-15.2	-3.4	29.9	39.8	221.3	46.1	224.8	60.8	226.0
601	Min Fx	STR 3/ 240	-354.2	-6.7	289.3	79.5	102.7	92.7	129.8	122.1	138.3
	Min Fy	STR 3/ 1	-22.5	-6.7	31.2	80.6	162.4	93.4	181.3	123.4	187.3
Joint	Min Fz	STR 3/ 129	-19.4	-3.4	29.5	39.8	174.1	46.1	178.6	60.8	180.1
156	Min Mx	STR 3/ 5	-29.9	-3.4	32.4	39.8	103.4	46.1	110.8	60.8	113.2
	Min My	STR 3/ 235	-349.4	-3.4	280.9	39.8	45.0	46.1	60.0	60.8	64.4
	Min Mz	STR 3/ 5	-29.9	-3.4	32.4	39.8	103.4	46.1	110.8	60.8	113.2
	Min Mxy	STR 3/ 235	-349.4	-3.4	280.9	39.8	45.0	46.1	60.0	60.8	64.4
	Min Mxz	STR 3/ 5	-29.9	-3.4	32.4	39.8	103.4	46.1	110.8	60.8	113.2
	Min Myz	STR 3/ 235	-349.4	-3.4	280.9	39.8	45.0	46.1	60.0	60.8	64.4

AASHTO Limit State: STR 3 - STRENGTH III

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
Load No. 7	Max Fx	STR 3/ 9	46.7	-2.9	-23.5	33.6	164.0	35.3	167.4	48.7	167.7
	Max Fy	STR 3/ 5	23.4	-2.9	-12.6	33.6	71.0	35.3	78.5	48.7	79.3
	Max Fz	STR 3/ 240	-158.7	-5.9	141.3	67.6	73.8	71.5	100.1	98.4	102.8
	Max Mx	STR 3/ 1	35.1	-5.9	-18.0	68.2	117.5	71.7	135.8	98.9	137.6
	Max My	STR 3/ 9	46.7	-2.9	-23.5	33.6	164.0	35.3	167.4	48.7	167.7
	Max Mz	STR 3/ 1	35.1	-5.9	-18.0	68.2	117.5	71.7	135.8	98.9	137.6
	Max Mxy	STR 3/ 9	46.7	-2.9	-23.5	33.6	164.0	35.3	167.4	48.7	167.7
	Max Mxz	STR 3/ 1	35.1	-5.9	-18.0	68.2	117.5	71.7	135.8	98.9	137.6
Member 602	Max Myz	STR 3/ 9	46.7	-2.9	-23.5	33.6	164.0	35.3	167.4	48.7	167.7
	Min Fx	STR 3/ 240	-158.7	-5.9	141.3	67.6	73.8	71.5	100.1	98.4	102.8
	Min Fy	STR 3/ 1	35.1	-5.9	-18.0	68.2	117.5	71.7	135.8	98.9	137.6
Joint 151	Min Fz	STR 3/ 9	46.7	-2.9	-23.5	33.6	164.0	35.3	167.4	48.7	167.7
	Min Mx	STR 3/ 5	23.4	-2.9	-12.6	33.6	71.0	35.3	78.5	48.7	79.3
	Min My	STR 3/ 235	-153.0	-2.9	132.2	33.6	28.7	35.3	44.2	48.7	45.5
	Min Mz	STR 3/ 5	23.4	-2.9	-12.6	33.6	71.0	35.3	78.5	48.7	79.3
	Min Mxy	STR 3/ 235	-153.0	-2.9	132.2	33.6	28.7	35.3	44.2	48.7	45.5
	Min Mxz	STR 3/ 5	23.4	-2.9	-12.6	33.6	71.0	35.3	78.5	48.7	79.3
	Min Myz	STR 3/ 235	-153.0	-2.9	132.2	33.6	28.7	35.3	44.2	48.7	45.5
Load No. 8	Max Fx	STR 3/ 9	87.9	-2.5	-66.5	28.7	115.4	26.5	118.9	39.0	118.4
	Max Fy	STR 3/ 5	61.9	-2.5	-50.5	28.7	45.4	26.5	53.7	39.0	52.6
	Max Fz	STR 3/ 240	-32.7	-5.0	36.8	58.9	54.6	54.5	80.3	80.2	77.1
	Max Mx	STR 3/ 10	53.7	-5.0	-39.2	58.9	79.0	54.5	98.6	80.2	96.0
	Max My	STR 3/ 19	46.3	-2.5	-28.5	28.7	116.5	26.5	120.0	39.0	119.5
	Max Mz	STR 3/ 10	53.7	-5.0	-39.2	58.9	79.0	54.5	98.6	80.2	96.0
	Max Mxy	STR 3/ 19	46.3	-2.5	-28.5	28.7	116.5	26.5	120.0	39.0	119.5
	Max Mxz	STR 3/ 10	53.7	-5.0	-39.2	58.9	79.0	54.5	98.6	80.2	96.0
Member 603	Max Myz	STR 3/ 19	46.3	-2.5	-28.5	28.7	116.5	26.5	120.0	39.0	119.5
	Min Fx	STR 3/ 240	-32.7	-5.0	36.8	58.9	54.6	54.5	80.3	80.2	77.1
	Min Fy	STR 3/ 1	74.9	-5.0	-58.5	58.7	80.4	54.0	99.5	79.8	96.9
Joint 146	Min Fz	STR 3/ 9	87.9	-2.5	-66.5	28.7	115.4	26.5	118.9	39.0	118.4
	Min Mx	STR 3/ 5	61.9	-2.5	-50.5	28.7	45.4	26.5	53.7	39.0	52.6
	Min My	STR 3/ 215	36.4	-2.5	-30.2	28.7	20.3	26.5	35.2	39.0	33.3
	Min Mz	STR 3/ 5	61.9	-2.5	-50.5	28.7	45.4	26.5	53.7	39.0	52.6
	Min Mxy	STR 3/ 215	36.4	-2.5	-30.2	28.7	20.3	26.5	35.2	39.0	33.3
	Min Mxz	STR 3/ 5	61.9	-2.5	-50.5	28.7	45.4	26.5	53.7	39.0	52.6
	Min Myz	STR 3/ 215	36.4	-2.5	-30.2	28.7	20.3	26.5	35.2	39.0	33.3

AASHTO Limit State: STR 3 - STRENGTH III

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	STR 3/ 39	139.7	-2.1	-132.1	25.5	79.5	19.3	83.4	32.0	81.8
	Max Fy	STR 3/ 5	93.1	-2.1	-91.6	25.5	26.7	19.3	36.9	32.0	33.0
	Max Fz	STR 3/ 210	13.9	-4.3	-8.7	53.1	37.7	40.9	65.1	67.0	55.6
	Max Mx	STR 3/ 10	80.8	-4.3	-75.3	53.1	50.2	40.9	73.1	67.0	64.8
	Max My	STR 3/ 49	98.5	-2.1	-89.6	25.5	82.5	19.3	86.3	32.0	84.7
Load No.	Max Mz	STR 3/ 10	80.8	-4.3	-75.3	53.1	50.2	40.9	73.1	67.0	64.8
9	Max Mxy	STR 3/ 48	96.5	-3.1	-88.4	37.0	78.1	28.3	86.4	46.5	83.1
	Max Mxz	STR 3/ 10	80.8	-4.3	-75.3	53.1	50.2	40.9	73.1	67.0	64.8
Member	Max Myz	STR 3/ 49	98.5	-2.1	-89.6	25.5	82.5	19.3	86.3	32.0	84.7
604	Min Fx	STR 3/ 210	13.9	-4.3	-8.7	53.1	37.7	40.9	65.1	67.0	55.6
	Min Fy	STR 3/ 1	103.8	-4.3	-98.9	52.2	51.9	39.9	73.6	65.7	65.5
Joint	Min Fz	STR 3/ 39	139.7	-2.1	-132.1	25.5	79.5	19.3	83.4	32.0	81.8
141	Min Mx	STR 3/ 5	93.1	-2.1	-91.6	25.5	26.7	19.3	36.9	32.0	33.0
	Min My	STR 3/ 185	78.5	-2.1	-78.8	25.5	11.3	19.3	27.9	32.0	22.4
	Min Mz	STR 3/ 5	93.1	-2.1	-91.6	25.5	26.7	19.3	36.9	32.0	33.0
	Min Mxy	STR 3/ 185	78.5	-2.1	-78.8	25.5	11.3	19.3	27.9	32.0	22.4
	Min Mxz	STR 3/ 5	93.1	-2.1	-91.6	25.5	26.7	19.3	36.9	32.0	33.0
	Min Myz	STR 3/ 185	78.5	-2.1	-78.8	25.5	11.3	19.3	27.9	32.0	22.4
	Max Fx	STR 3/ 39	147.8	-1.8	-175.6	23.2	44.1	13.7	49.8	27.0	46.2
	Max Fy	STR 3/ 5	102.2	-1.8	-125.3	23.2	9.5	13.7	25.1	27.0	16.7
	Max Fz	STR 3/ 210	16.8	-3.6	-16.7	47.9	21.9	29.0	52.6	56.0	36.3
	Max Mx	STR 3/ 1	108.1	-3.6	-129.3	48.2	26.0	28.6	54.7	56.0	38.6
	Max My	STR 3/ 59	87.5	-1.8	-99.8	23.2	49.7	13.7	54.9	27.0	51.6
Load No.	Max Mz	STR 3/ 10	88.3	-3.6	-104.8	47.9	25.0	29.0	54.0	56.0	38.3
10	Max Mxy	STR 3/ 56	83.6	-3.5	-97.3	46.6	38.1	27.6	60.2	54.2	47.1
	Max Mxz	STR 3/ 1	108.1	-3.6	-129.3	48.2	26.0	28.6	54.7	56.0	38.6
Member	Max Myz	STR 3/ 59	87.5	-1.8	-99.8	23.2	49.7	13.7	54.9	27.0	51.6
605	Min Fx	STR 3/ 210	16.8	-3.6	-16.7	47.9	21.9	29.0	52.6	56.0	36.3
	Min Fy	STR 3/ 1	108.1	-3.6	-129.3	48.2	26.0	28.6	54.7	56.0	38.6
Joint	Min Fz	STR 3/ 39	147.8	-1.8	-175.6	23.2	44.1	13.7	49.8	27.0	46.2
136	Min Mx	STR 3/ 5	102.2	-1.8	-125.3	23.2	9.5	13.7	25.1	27.0	16.7
	Min My	STR 3/ 185	90.9	-1.8	-113.0	23.2	0.7	13.7	23.2	27.0	13.7
	Min Mz	STR 3/ 5	102.2	-1.8	-125.3	23.2	9.5	13.7	25.1	27.0	16.7
	Min Mxy	STR 3/ 185	90.9	-1.8	-113.0	23.2	0.7	13.7	23.2	27.0	13.7
	Min Mxz	STR 3/ 5	102.2	-1.8	-125.3	23.2	9.5	13.7	25.1	27.0	16.7
	Min Myz	STR 3/ 185	90.9	-1.8	-113.0	23.2	0.7	13.7	23.2	27.0	13.7

Limit State: STRENGTH III

FR Friction
LF: 1
FR1: CR+SH+PT_EOC
FR2: CR+SH+PT_D10K

DC DL Structural Components & Attachments
LF1: 1.25
LF2: 0.9
DC1: DC

TU Uniform Temperature
LF: 0.5
TU1: TU-
TU2: TU+
TU3: TU+Temp. Diff.

WS Wind Load on Structure
LF: 1.4
WS1: WS_0 DEG
WS2: WS_15 DEG
WS3: WS_30 DEG
WS4: WS_45 DEG
WS5: WS_60 DEG
WS6: WS_-15 DEG
WS7: WS_-30 DEG
WS8: WS_-45 DEG
WS9: WS_-60 DEG
WS10: WS+WUP

DW DL Wearing Surfaces & Utilities
LF1: 1.5
LF2: 0.65
DW1: DW

Combo ID	Load Combinations
STR 3/ 1	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS1*1.40)
STR 3/ 2	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS2*1.40)
STR 3/ 3	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS3*1.40)
STR 3/ 4	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS4*1.40)
STR 3/ 5	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS5*1.40)
STR 3/ 6	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS6*1.40)
STR 3/ 7	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS7*1.40)
STR 3/ 8	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS8*1.40)
STR 3/ 9	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS9*1.40)
STR 3/ 10	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU1*0.50 + WS10*1.40)
STR 3/ 11	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU2*0.50 + WS1*1.40)
STR 3/ 12	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU2*0.50 + WS2*1.40)
STR 3/ 13	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU2*0.50 + WS3*1.40)
STR 3/ 14	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU2*0.50 + WS4*1.40)
STR 3/ 15	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU2*0.50 + WS5*1.40)
STR 3/ 16	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU2*0.50 + WS6*1.40)
STR 3/ 17	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU2*0.50 + WS7*1.40)
STR 3/ 18	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU2*0.50 + WS8*1.40)
STR 3/ 19	1.00*(DC1*1.25 + DW1*1.50 + FR1*1.00 + TU2*0.50 + WS9*1.40)

Limit State: STRENGTH III

FR Friction
LF: 1
FR1: CR+SH+PT_EOC
FR2: CR+SH+PT_D10K

DC DL Structural Components & Attachments
LF1: 1.25
LF2: 0.9
DC1: DC

TU Uniform Temperature
LF: 0.5
TU1: TU-
TU2: TU+
TU3: TU+Temp. Diff.

WS Wind Load on Structure
LF: 1.4
WS1: WS_0 DEG
WS2: WS_15 DEG
WS3: WS_30 DEG
WS4: WS_45 DEG
WS5: WS_60 DEG
WS6: WS_-15 DEG
WS7: WS_-30 DEG
WS8: WS_-45 DEG
WS9: WS_-60 DEG
WS10: WS+WUP

DW DL Wearing Surfaces & Utilities
LF1: 1.5
LF2: 0.65
DW1: DW

Load (Row) Number	User's Load ID	Member ID	Joint ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)
1	CR+SH+PT_D10K	501	106	296.8	0	134.7	0	17.5	0
2	CR+SH+PT_D10K	502	111	97.2	0	48.8	0	16.5	0
3	CR+SH+PT_D10K	503	116	-16.4	0	-10	0	12.5	0
4	CR+SH+PT_D10K	504	121	-83.6	0	-64.1	0	10.8	0
5	CR+SH+PT_D10K	505	126	-110.9	0	-141.7	0	5.7	0
6	CR+SH+PT_D10K	601	156	-270.4	0	213.4	0	-16	0
7	CR+SH+PT_D10K	602	151	-101.1	0	84.6	0	-12.2	0
8	CR+SH+PT_D10K	603	146	10.1	0	-9.4	0	-4.7	0
9	CR+SH+PT_D10K	604	141	76.2	0	-78.4	0	2.3	0
10	CR+SH+PT_D10K	605	136	90.3	0	-113	0	0.3	0
1	CR+SH+PT_EOC	501	106	99.3	0	45.1	0	7.8	0
2	CR+SH+PT_EOC	502	111	20.6	0	10.3	0	7.1	0
3	CR+SH+PT_EOC	503	116	-25.7	0	-15.3	0	5.5	0
4	CR+SH+PT_EOC	504	121	-53.5	0	-40.9	0	4.6	0
5	CR+SH+PT_EOC	505	126	-61.7	0	-78.7	0	2.6	0
6	CR+SH+PT_EOC	601	156	-86.5	0	68.2	0	-7.5	0
7	CR+SH+PT_EOC	602	151	-23.7	0	19.7	0	-6.3	0
8	CR+SH+PT_EOC	603	146	21.4	0	-19.6	0	-3.6	0
9	CR+SH+PT_EOC	604	141	50.9	0	-52.4	0	-0.2	0
10	CR+SH+PT_EOC	605	136	56.4	0	-70.6	0	-1.3	0

Load (Row) Number	User's Load ID	Member ID	Joint ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)
1	DC	501	106	4.3	0	18.8	0	-379.4	0
2	DC	502	111	-6.3	0	10.5	0	-248.4	0
3	DC	503	116	-14.9	0	1.9	0	-145	0
4	DC	504	121	-19.9	0	-7.4	0	-69.8	0
5	DC	505	126	-16.2	0	-15.5	0	-23	0
6	DC	601	156	12	0	1.3	0	134.8	0
7	DC	602	151	13.6	0	-2.1	0	97.9	0
8	DC	603	146	12.1	0	-3.2	0	66.7	0
9	DC	604	141	10.2	0	-4.2	0	41.8	0
10	DC	605	136	6.6	0	-3.4	0	22.7	0
1	DW	501	106	-1.4	0	-0.7	0	0.7	0
2	DW	502	111	-10	0	-5.1	0	1.1	0
3	DW	503	116	-14.3	0	-8.5	0	0.8	0
4	DW	504	121	-15.8	0	-12	0	0.6	0
5	DW	505	126	-13.2	0	-16.8	0	0.3	0
6	DW	601	156	6.5	0	-5.1	0	0.6	0
7	DW	602	151	9.5	0	-8	0	0.8	0
8	DW	603	146	11.7	0	-10.6	0	0.8	0
9	DW	604	141	13	0	-13.3	0	0.9	0
10	DW	605	136	10.5	0	-13.1	0	1	0
1	TU-	501	106	-78.1	0	-35.5	0	0	0
2	TU-	502	111	-54.9	0	-27.8	0	-0.2	0
3	TU-	503	116	-39.6	0	-23.4	0	0.8	0
4	TU-	504	121	-36.7	0	-28	0	1.8	0
5	TU-	505	126	-65.5	0	-83.5	0	4.4	0
6	TU-	601	156	78.5	0	-62	0	0.9	0
7	TU-	602	151	55	0	-46.2	0	0.4	0
8	TU-	603	146	41.6	0	-38	0	-1.1	0
9	TU-	604	141	41.2	0	-42.5	0	-3	0
10	TU-	605	136	55.3	0	-69.5	0	-5.2	0
1	TU+	501	106	78.1	0	35.5	0	0	0
2	TU+	502	111	54.9	0	27.8	0	0.2	0
3	TU+	503	116	39.6	0	23.4	0	-0.8	0
4	TU+	504	121	36.7	0	28	0	-1.8	0
5	TU+	505	126	65.5	0	83.5	0	-4.4	0
6	TU+	601	156	-78.5	0	62	0	-0.9	0
7	TU+	602	151	-55	0	46.2	0	-0.4	0
8	TU+	603	146	-41.6	0	38	0	1.1	0
9	TU+	604	141	-41.2	0	42.5	0	3	0
10	TU+	605	136	-55.3	0	69.5	0	5.2	0
1	TU+Temp. Diff.	501	106	171.7	0	78	0	1.2	0
2	TU+Temp. Diff.	502	111	119.7	0	60.5	0	1.8	0
3	TU+Temp. Diff.	503	116	81.5	0	48.1	0	0.5	0
4	TU+Temp. Diff.	504	121	57.8	0	44	0	-0.6	0
5	TU+Temp. Diff.	505	126	72	0	91.8	0	-4.8	0
6	TU+Temp. Diff.	601	156	-173.2	0	136.8	0	-3.6	0
7	TU+Temp. Diff.	602	151	-117.3	0	98.4	0	-2.5	0
8	TU+Temp. Diff.	603	146	-80.3	0	73.3	0	0.2	0
9	TU+Temp. Diff.	604	141	-63.4	0	65.3	0	2.7	0
10	TU+Temp. Diff.	605	136	-65.3	0	82	0	6.1	0
1	WS_0 DEG	501	106	0	-7.3	0	74.5	0	-164.5
2	WS_0 DEG	502	111	0	-6	0	54.9	0	-107.4
3	WS_0 DEG	503	116	0	-4.7	0	39.8	0	-63.6
4	WS_0 DEG	504	121	0	-3.4	0	29.8	0	-32.8
5	WS_0 DEG	505	126	0	-2.5	0	27.9	0	-14.5
6	WS_0 DEG	601	156	0	-4.8	0	57.6	0	66.7
7	WS_0 DEG	602	151	0	-4.2	0	48.7	0	51.2
8	WS_0 DEG	603	146	0	-3.6	0	41.9	0	38.6
9	WS_0 DEG	604	141	0	-3.1	0	37.3	0	28.5
10	WS_0 DEG	605	136	0	-2.6	0	34.4	0	20.4

Load (Row) Number	User's Load ID	Member ID	Joint ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)
1	WS_15 DEG	501	106	-3.3	-7.1	-0.6	72.6	-19.6	-159.7
2	WS_15 DEG	502	111	-3.4	-5.8	-0.9	53.6	-14.4	-104.5
3	WS_15 DEG	503	116	-3.1	-4.5	-1.1	39	-9.9	-61.9
4	WS_15 DEG	504	121	-2.1	-3.3	-0.9	29.2	-6.3	-32
5	WS_15 DEG	505	126	0.1	-2.4	0.9	27.3	-3.4	-14.1
6	WS_15 DEG	601	156	-1.5	-4.7	0.3	55.9	-12.5	64.7
7	WS_15 DEG	602	151	-2.4	-4.1	1.2	47.2	-9.9	49.6
8	WS_15 DEG	603	146	-2.7	-3.5	1.7	40.6	-7.4	37.4
9	WS_15 DEG	604	141	-2.3	-3	1.6	36.1	-5.3	27.6
10	WS_15 DEG	605	136	-1.4	-2.5	1	33.3	-3.5	19.7
1	WS_-15 DEG	501	106	3.3	-7.1	0.6	72.6	19.6	-159.7
2	WS_-15 DEG	502	111	3.4	-5.8	0.9	53.6	14.4	-104.5
3	WS_-15 DEG	503	116	3.1	-4.5	1.1	39	9.9	-61.9
4	WS_-15 DEG	504	121	2.1	-3.3	0.9	29.2	6.3	-32
5	WS_-15 DEG	505	126	-0.1	-2.4	-0.9	27.3	3.4	-14.1
6	WS_-15 DEG	601	156	1.5	-4.7	-0.3	55.9	12.5	64.7
7	WS_-15 DEG	602	151	2.4	-4.1	-1.2	47.2	9.9	49.6
8	WS_-15 DEG	603	146	2.7	-3.5	-1.7	40.6	7.4	37.4
9	WS_-15 DEG	604	141	2.3	-3	-1.6	36.1	5.3	27.6
10	WS_-15 DEG	605	136	1.4	-2.5	-1	33.3	3.5	19.7
1	WS_30 DEG	501	106	-6.5	-6.3	-1.3	64.8	-37.6	-142.6
2	WS_30 DEG	502	111	-6.5	-5.2	-1.8	47.8	-27.8	-93.3
3	WS_30 DEG	503	116	-5.9	-4	-2.1	34.7	-19.1	-55.3
4	WS_30 DEG	504	121	-3.9	-3	-1.7	26	-12.1	-28.6
5	WS_30 DEG	505	126	0.6	-2.2	2.1	24.4	-6.6	-12.6
6	WS_30 DEG	601	156	-3	-4.2	0.5	50	-24	57.8
7	WS_30 DEG	602	151	-4.7	-3.6	2.2	42.3	-19	44.4
8	WS_30 DEG	603	146	-5.3	-3.1	3.3	36.4	-14.3	33.5
9	WS_30 DEG	604	141	-4.3	-2.7	3	32.3	-10.3	24.7
10	WS_30 DEG	605	136	-2.4	-2.2	1.6	29.9	-6.8	17.7
1	WS_-30 DEG	501	106	6.4	-6.3	1.3	64.8	37.6	-142.7
2	WS_-30 DEG	502	111	6.5	-5.2	1.8	47.8	27.8	-93.3
3	WS_-30 DEG	503	116	5.9	-4	2.1	34.7	19.1	-55.3
4	WS_-30 DEG	504	121	3.9	-3	1.7	26	12.1	-28.6
5	WS_-30 DEG	505	126	-0.6	-2.2	-2.1	24.4	6.6	-12.6
6	WS_-30 DEG	601	156	3	-4.2	-0.5	50	24	57.8
7	WS_-30 DEG	602	151	4.7	-3.6	-2.3	42.3	19	44.4
8	WS_-30 DEG	603	146	5.3	-3.1	-3.3	36.4	14.3	33.5
9	WS_-30 DEG	604	141	4.3	-2.7	-3	32.3	10.3	24.7
10	WS_-30 DEG	605	136	2.4	-2.2	-1.6	29.9	6.8	17.7
1	WS_45 DEG	501	106	-9.3	-5.2	-1.9	53.5	-54	-117.4
2	WS_45 DEG	502	111	-9.3	-4.2	-2.6	39.6	-39.9	-76.9
3	WS_45 DEG	503	116	-8.5	-3.3	-3	28.8	-27.5	-45.6
4	WS_45 DEG	504	121	-5.6	-2.5	-2.4	21.6	-17.4	-23.6
5	WS_45 DEG	505	126	1	-1.8	3.2	20.1	-9.5	-10.4
6	WS_45 DEG	601	156	-4.3	-3.4	0.7	41	-34.5	47.4
7	WS_45 DEG	602	151	-6.8	-3	3.2	34.6	-27.3	36.4
8	WS_45 DEG	603	146	-7.6	-2.6	4.7	29.7	-20.5	27.3
9	WS_45 DEG	604	141	-6.2	-2.2	4.3	26.4	-14.8	20.2
10	WS_45 DEG	605	136	-3.4	-1.8	2.3	24.3	-9.7	14.3
1	WS_-45 DEG	501	106	9.3	-5.2	1.9	53.5	54	-117.4
2	WS_-45 DEG	502	111	9.3	-4.2	2.6	39.6	39.9	-76.9
3	WS_-45 DEG	503	116	8.5	-3.3	3	28.8	27.5	-45.6
4	WS_-45 DEG	504	121	5.6	-2.5	2.4	21.6	17.4	-23.6
5	WS_-45 DEG	505	126	-1	-1.8	-3.2	20.1	9.5	-10.4
6	WS_-45 DEG	601	156	4.3	-3.4	-0.7	41	34.5	47.4
7	WS_-45 DEG	602	151	6.8	-3	-3.2	34.6	27.3	36.4
8	WS_-45 DEG	603	146	7.6	-2.6	-4.7	29.7	20.5	27.3
9	WS_-45 DEG	604	141	6.2	-2.2	-4.3	26.4	14.8	20.2
10	WS_-45 DEG	605	136	3.4	-1.8	-2.3	24.3	9.7	14.3

Load (Row) Number	User's Load ID	Member ID	Joint ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)
1	WS_60 DEG	501	106	-11.3	-3.6	-2.2	37.6	-65.7	-82
2	WS_60 DEG	502	111	-11.4	-3	-3.1	27.9	-48.6	-53.8
3	WS_60 DEG	503	116	-10.3	-2.3	-3.7	20.4	-33.5	-32
4	WS_60 DEG	504	121	-6.8	-1.7	-2.9	15.3	-21.2	-16.6
5	WS_60 DEG	505	126	1.1	-1.2	3.9	14.2	-11.6	-7.3
6	WS_60 DEG	601	156	-5.3	-2.4	0.9	28.4	-42.1	32.9
7	WS_60 DEG	602	151	-8.3	-2.1	3.9	24	-33.2	25.2
8	WS_60 DEG	603	146	-9.3	-1.8	5.7	20.5	-25	18.9
9	WS_60 DEG	604	141	-7.6	-1.5	5.2	18.2	-18	13.8
10	WS_60 DEG	605	136	-4.2	-1.3	2.8	16.6	-11.8	9.8
1	WS_-60 DEG	501	106	11.3	-3.6	2.3	37.6	65.7	-82
2	WS_-60 DEG	502	111	11.4	-3	3.1	27.9	48.6	-53.8
3	WS_-60 DEG	503	116	10.3	-2.3	3.7	20.4	33.5	-32
4	WS_-60 DEG	504	121	6.8	-1.7	2.9	15.3	21.2	-16.6
5	WS_-60 DEG	505	126	-1.1	-1.2	-3.9	14.2	11.6	-7.3
6	WS_-60 DEG	601	156	5.2	-2.4	-0.9	28.4	42.1	32.9
7	WS_-60 DEG	602	151	8.3	-2.1	-3.9	24	33.2	25.2
8	WS_-60 DEG	603	146	9.3	-1.8	-5.7	20.5	25	18.9
9	WS_-60 DEG	604	141	7.6	-1.5	-5.2	18.2	17.9	13.8
10	WS_-60 DEG	605	136	4.2	-1.3	-2.8	16.6	11.8	9.8
1	WS+WUP	501	106	2.4	-7.2	1.1	69.8	1.5	-160.1
2	WS+WUP	502	111	12.7	-5.9	6.4	50.3	-1.9	-103.2
3	WS+WUP	503	116	18.1	-4.6	10.7	35.2	-1	-59.6
4	WS+WUP	504	121	20.5	-3.3	15.6	24.4	-0.9	-28.8
5	WS+WUP	505	126	17.5	-2.3	22.3	22.2	-0.4	-11.5
6	WS+WUP	601	156	-8.7	-4.8	6.9	56.8	-0.9	66.2
7	WS+WUP	602	151	-12.4	-4.2	10.4	48.3	-1	51.1
8	WS+WUP	603	146	-15.1	-3.6	13.8	42.1	-1	38.9
9	WS+WUP	604	141	-16.4	-3.1	16.8	37.9	-1.2	29.2
10	WS+WUP	605	136	-14.1	-2.6	17.5	34.2	-0.7	20.7

Section IV

South Landing Canopy

Design Summary

Project: FIU Pedestrian Bridge

Project No. : 2262.03

Design Task: South Landing Canopy Design Summary

Designer: Erika N. Hango, P.E.

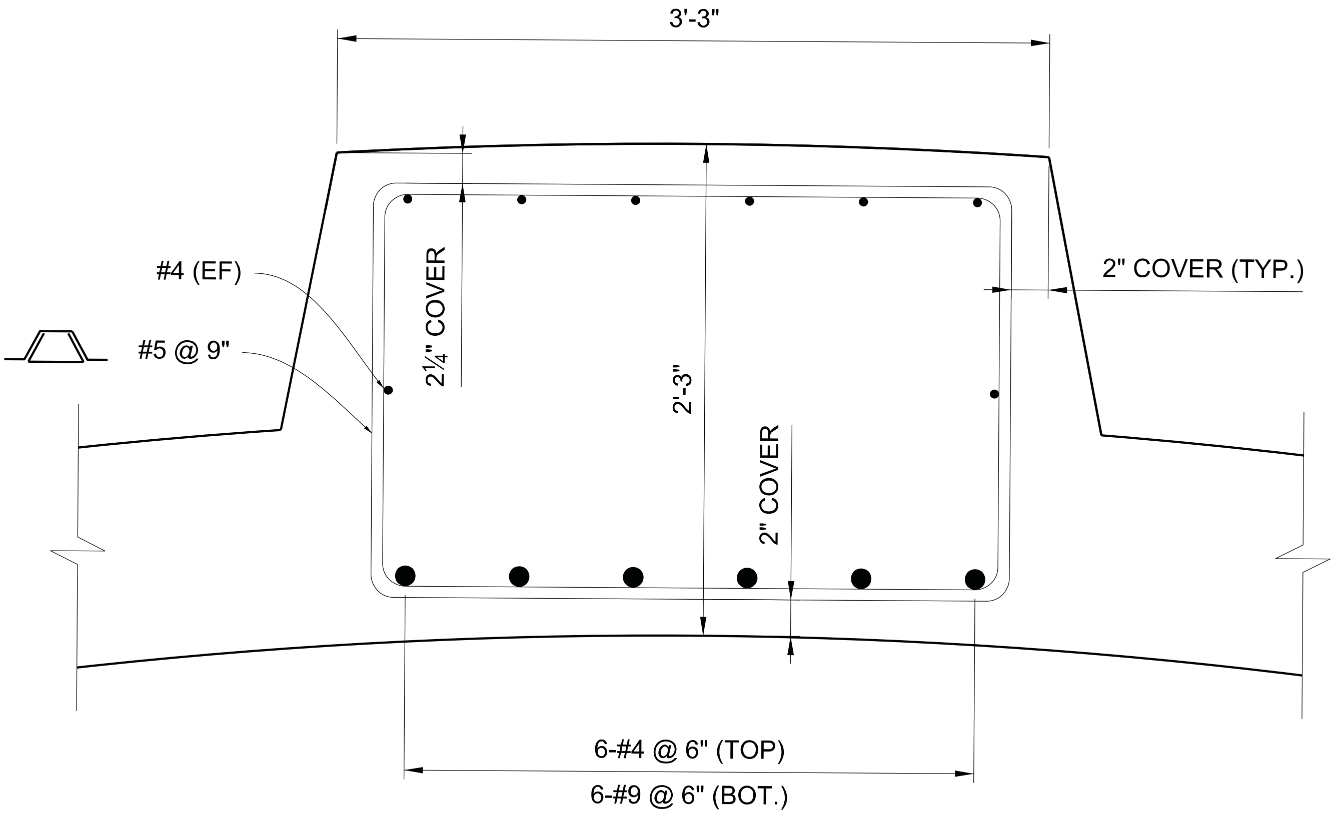
Design Summary:

This binder contains the calculations performed for the 90% design of the canopy at the south landing. The calculations were prepared in accordance with the project design criteria, AASHTO LRFD Bridge Design Specifications 7th Edition with 2015 Interim Revisions, FDOT Structures Design Guidelines (January 2015), AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges 2nd Edition (2009), and the Florida Building Code 5th Edition (2014). The intent of this design was to determine the required concrete dimensions and the reinforcement requirements for each canopy element.

The south landing was modeled using LARSA 4D (V7.08.05). Relevant member forces were extracted from the model. Load combinations were calculated with PT Column (V2.6.3) and by hand to determine the governing factored loads for design. The Strength I, III, and V and Service I and III limit states were investigated.

The canopy beam longitudinal reinforcement was designed for positive flexure per AASHTO LRFD 5.7.3.2. Minimum reinforcement was checked per AASHTO LRFD 5.7.3.3.2 and control of cracking by distribution of reinforcement was checked per AASHTO LRFD 5.7.3.4. Shrinkage and temperature reinforcement was determined in accordance with AASHTO LRFD 5.10.8. Beam transverse reinforcement was designed for shear per AASHTO LRFD 5.8.3.3 and combined shear and torsion per AASHTO LRFD 5.8.3.6. Minimum transverse reinforcement was checked per AASHTO LRFD 5.8.2.5 and the provided longitudinal reinforcement was checked per AASHTO LRFD 5.8.3.6.3.

Column longitudinal reinforcement was designed for biaxial flexure and axial load using the PT Column program in accordance with AASHTO LRFD. Moment magnification factors were calculated for both transverse and longitudinal directions per AASHTO LRFD 4.5.3.2.2b. Service III stresses were checked per FDOT SDG 3.10 and ACI 318-14 24.3.2.1. Column transverse reinforcement was designed per AASHTO LRFD 5.8.3.3 and minimum reinforcement was checked per AASHTO LRFD 5.8.2.5.



CANOPY BEAM

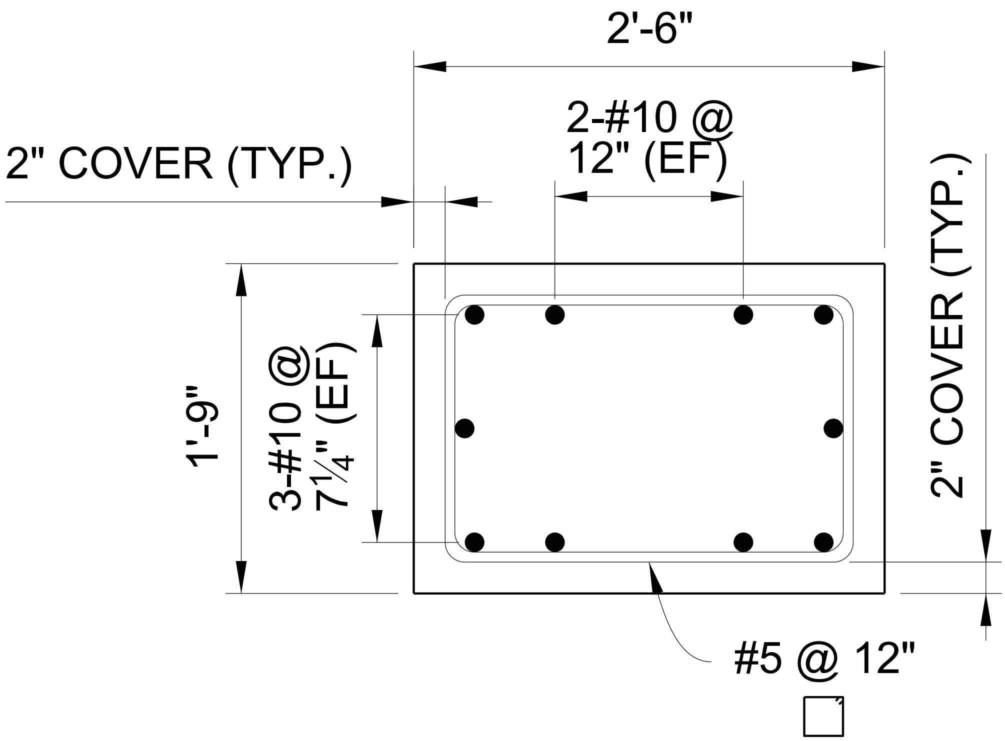
+M: 6-#9

V: #5 STIRRUPS @ 9"

T+S: #4 @ 12"

ENH 9/30/16

Note: For canopy transverse and longitudinal reinforcement, see typical canopy design. For canopy diaphragm transverse reinforcement, see canopy end diaphragm design.

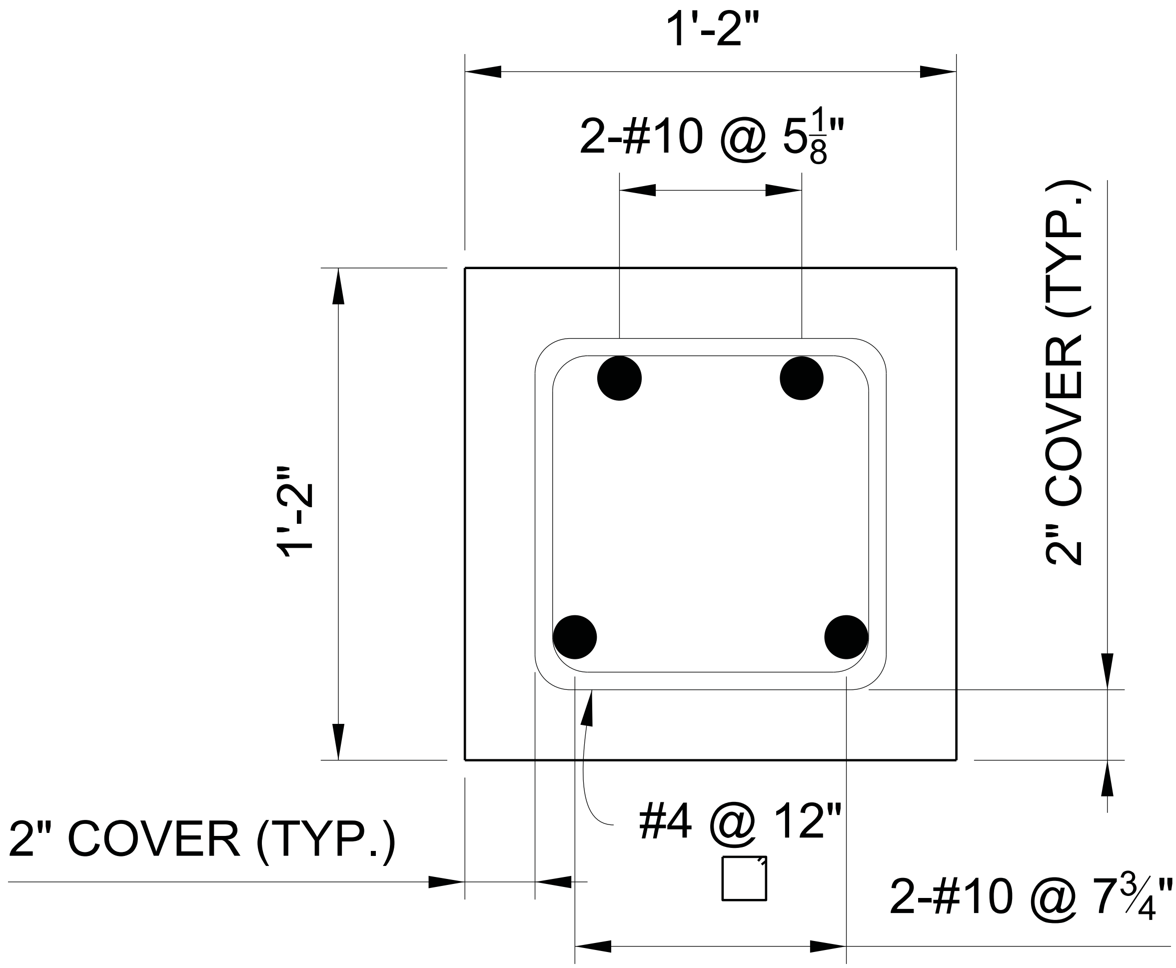


1.75' x 2.5' CANOPY SUPPORT COLUMN

10-#10 BARS

#5 TIES @ 12"

ENH 8/20/16



14" x 14" CANOPY SUPPORT POST

4-#10 BARS

#4 TIES @ 12"

ENH 8/20/16

FIGG	Project: FIU PEDESTRIAN BRIDGE	Date: 10/3/16	Page / Of
	Project Number: 22162.03	Designed: ENH	
	Description: SOUTH CANOPY WIND LOAD	Checked:	

WIND UPLIFT – STRENGTH III

Per AASHTO LRFD 3.8.2 :

$W = 0.020 \text{ ksf } (16 \text{ ft}) = \underline{\underline{0.32 \text{ k/ft}}}$ applied as longitudinal line load at quarter point of canopy width

$M = (0.32 \text{ k/ft})\left(\frac{16 \text{ ft}}{4}\right) = \underline{\underline{1.28 \text{ k}\cdot\text{ft/ft}}}$

These loads are applied to South Landing LARSA model.

FIGG

FIU Pedestrian Bridge - South Landing

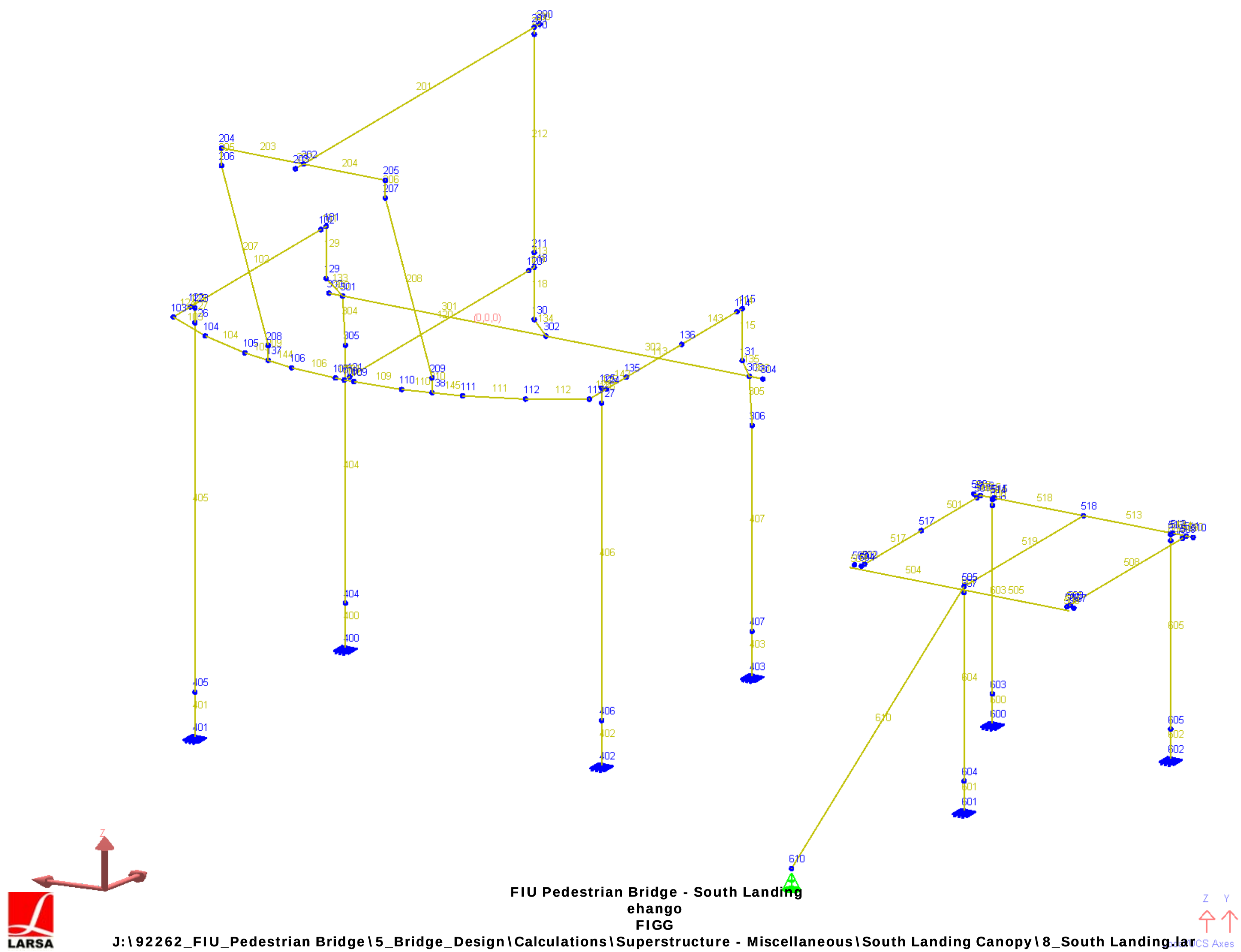
Tuesday, October 04, 2016

ehango
FIGG

424 North Calhoun Street
Tallahassee, Florida 32301
Tel: 850.224.7400

Graphics View 1

Zoom 1.563X



FIU Pedestrian Bridge - South Landing
ehango
FIGG
J:\92262_FIU_Pedestrian Bridge\5_Bridge_Design\Calculations\Superstructure - Miscellaneous\South Landing Canopy\8_South Landing.lar
Last Analysis Run : 10/4/2016 7:21:49 AM

Load Cases

ID	Name	Analysis Type	Class	Status	Weight Factor X	Weight Factor Y	Weight Factor Z	Is Dynamic	Assigned to Load Combinatio	# of Joint Loads	# of Support Loads	# of Member Loads	# of Member Thermal	# of Plate Loads	# of Moving Loads	# of THA Loading	# of THA Initial
1	Stair DC	Static	Dead Load	Activ	0.0	0.0	0.0	No	Yes	0	0	10	0	0	0	0	0
2	Stair LL	Static	Pedestrian Live Load	Activ	0.0	0.0	0.0	No	Yes	0	0	5	0	0	0	0	0
3	Bridge DC	Static	Dead Load	Activ	0.0	0.0	0.0	No	Yes	0	0	12	0	0	0	0	0
4	Bridge DW	Static	Dead Load of	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
5	Bridge LL Deck (Full)	Static	Live Load	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
6	Bridge LL Deck (Main)	Static	Live Load	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
7	Bridge LL Deck (Back)	Static	Live Load	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
8	Bridge LL Roof (Full)	Static	Live Load	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
9	Bridge LL Roof (Main)	Static	Live Load	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
10	Bridge LL Roof (Back)	Static	Live Load	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
11	Bridge LL Offset (Full)	Static	Live Load	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
12	Bridge LL Offset (Main)	Static	Live Load	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
13	Bridge LL Offset (Back)	Static	Live Load	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
14	WS 0 deg	Static	Wind Load on	Activ	0.0	0.0	0.0	No	Yes	2	0	27	0	0	0	0	0
15	WS 15 deg	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
16	WS 30 deg	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
17	WS 45 deg	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
18	WS 60 deg	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
19	WS -15 deg	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
20	WS -30 deg	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
21	WS -45 deg	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
22	WS -60 deg	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
23	WS 0 deg (70 mph)	Static	Wind Load on	Activ	0.0	0.0	0.0	No	Yes	2	0	27	0	0	0	0	0
24	WS 15 deg (70 mph)	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
25	WS 30 deg (70 mph)	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
26	WS 45 deg (70 mph)	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
27	WS 60 deg (70 mph)	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
28	WS -15 deg (70 mph)	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
29	WS -30 deg (70 mph)	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
30	WS -45 deg (70 mph)	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
31	WS -60 deg (70 mph)	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
32	TU+	Static	Temperature	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
33	TU-	Static	Temperature	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0

Load Cases

ID	Name	Analysis Type	Class	Status	Weight Factor X	Weight Factor Y	Weight Factor Z	Is Dynamic	Assigned to Load Combinatio	# of Joint Loads	# of Support Loads	# of Member Loads	# of Member Thermal	# of Plate Loads	# of Moving Loads	# of THA Loading	# of THA Initial
34	TU+ Temp. Diff.	Static	Temperature	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
35	Landing DC	Static	Dead Load	Activ	0.0	0.0	0.0	No	Yes	0	0	42	0	0	0	0	0
36	Landing LL	Static	Pedestrian Live Load	Activ	0.0	0.0	0.0	No	Yes	0	0	17	0	0	0	0	0
37	Self Weight	Static	Dead Load	Activ	0.0	0.0	-1.0	No	Yes	0	0	0	0	0	0	0	0
38	WS 0 deg with Uplift	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	2	0	29	0	0	0	0	0
39	WS 0 deg from West	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	3	0	19	0	0	0	0	0
40	WS 0 deg from West (70 mph)	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	3	0	19	0	0	0	0	0
41	WS 0 deg from West with Uplift	Static	Wind Load on	Activ	0.0	0.0	0.0	No	No	3	0	21	0	0	0	0	0
42	WS 90 deg	Static	Wind Load on	Activ	0.0	0.0	0.0	No	Yes	5	0	7	0	0	0	0	0
43	WS 90 deg (70 mph)	Static	Wind Load on	Activ	0.0	0.0	0.0	No	Yes	5	0	7	0	0	0	0	0
48	Canopy Roof LL	Static	Roof Live Load	Activ	0.0	0.0	0.0	No	No	0	0	3	0	0	0	0	0
49	CR+SH+PT (EOC)	Static	Creep	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
50	CR+SH+PT (D10K)	Static	Creep	Activ	0.0	0.0	0.0	No	No	0	0	12	0	0	0	0	0
51	Additional Canopy DL	Static	Dead Load	Activ	0.0	0.0	0.0	No	No	2	0	0	0	0	0	0	0

LOAD CASE WS 0 deg (70 mph), Member Loads

Member	Type	Direction	Magnitude at Start (kips or kips-ft)	Magnitude at End (kips or kips-ft)	Start Position (x/L)	End Position from start (x/L)
301	Point Force	Global X	0.0000		0.6600	
302	Point Force	Global X	0.0000		0.3400	
301	Point Force	Global Y	8.0000		0.6600	
302	Point Force	Global Y	8.0000		0.3400	
301	Point Force	Global Z	-25.0000		0.6600	
302	Point Force	Global Z	25.0000		0.3400	
301	Point Moment	Global Z	9.0000		0.6600	
302	Point Moment	Global Z	9.0000		0.3400	
301	Point Moment	Global Y	28.0000		0.6600	
302	Point Moment	Global Y	-28.0000		0.3400	
301	Point Moment	Global X	-13.0000		0.6600	
302	Point Moment	Global X	-13.0000		0.3400	
406	Point Force	Global Y	0.1000		0.1000	
406	Point Moment	Global Z	-0.1000		0.1000	
407	Point Force	Global Y	0.7000		0.4200	
126	Point Force	Global Y	0.1000		0.2300	

LOAD CASE WS 0 deg (70 mph), Member Loads

Member	Type	Direction	Magnitude at Start (kips or kips-ft)	Magnitude at End (kips or kips-ft)	Start Position (x/L)	End Position from start (x/L)
111	Point Force	Global Y	0.1000		0.4300	
212	Point Force	Global Y	0.4000		0.5000	
208	Point Force	Global Y	0.2000		0.5000	
201	Point Force	Global Y	0.9000		0.5000	
407	Point Moment	Global Z	0.3000		0.4200	
508	Point Force	Global Y	2.5000		0.0600	
508	Point Force	Global Y	1.6000		0.0000	
508	Point Moment	Global X	14.1000		0.0600	
508	Point Moment	Global Z	-4.8000		0.0000	
143	Point Moment	Global X	1.3000		0.0000	
143	Point Force	Global Y	0.9000		0.0000	

LOAD CASE WS 0 deg (70 mph), Joint Loads

Joint	X-Force (kips)	Y-Force (kips)	Z-Force (kips)	X-Moment (kips-ft)	Y-Moment (kips-ft)	Z-Moment (kips-ft)
304	0.0000	0.3000	0.0000	-0.3000	0.0000	0.0000
113	0.0000	1.1000	0.0000	-5.9000	0.0000	0.0000

LOAD CASE WS 0 deg with Uplift, Member Loads

Member	Type	Direction	Magnitude at Start (kips or kips-ft)	Magnitude at End (kips or kips-ft)	Start Position (x/L)	End Position from start (x/L)
301	Point Force	Global X	1.0000		0.6600	
302	Point Force	Global X	0.0000		0.3400	
301	Point Force	Global Y	19.0000		0.6600	
302	Point Force	Global Y	19.0000		0.3400	
301	Point Force	Global Z	-95.0000		0.6600	
302	Point Force	Global Z	149.0000		0.3400	
301	Point Moment	Global Z	21.0000		0.6600	
302	Point Moment	Global Z	21.0000		0.3400	
301	Point Moment	Global Y	105.0000		0.6600	
302	Point Moment	Global Y	-164.0000		0.3400	
301	Point Moment	Global X	-30.0000		0.6600	
302	Point Moment	Global X	-30.0000		0.3400	

LOAD CASE WS 0 deg with Uplift, Member Loads

Member	Type	Direction	Magnitude at Start (kips or kips-ft)	Magnitude at End (kips or kips-ft)	Start Position (x/L)	End Position from start (x/L)
406	Point Force	Global Y	0.6000		0.1000	
406	Point Moment	Global Z	-0.4000		0.1000	
407	Point Force	Global Y	3.2000		0.4200	
126	Point Force	Global Y	0.4000		0.2300	
111	Point Force	Global Y	0.5000		0.4300	
212	Point Force	Global Y	1.8000		0.5000	
208	Point Force	Global Y	1.0000		0.5000	
201	Point Force	Global Y	4.2000		0.5000	
407	Point Moment	Global Z	1.6000		0.4200	
508	Point Force	Global Y	11.5000		0.0600	
508	Point Force	Global Y	1.6000		0.0000	
508	Point Moment	Global X	64.8000		0.0600	
508	Point Moment	Global Z	-4.8000		0.0000	
143	Point Moment	Global X	5.8000		0.0000	
143	Point Force	Global Y	4.0000		0.0000	
201	Uniform Force	Global Z	0.3200		0.0000	1.0000
201	Uniform Moment	Global X	-1.2800		0.0000	1.0000

LOAD CASE WS 0 deg with Uplift, Joint Loads

Joint	X-Force (kips)	Y-Force (kips)	Z-Force (kips)	X-Moment (kips-ft)	Y-Moment (kips-ft)	Z-Moment (kips-ft)
304	0.0000	1.3000	0.0000	-1.2000	0.0000	0.0000
113	0.0000	1.1000	0.0000	-5.9000	0.0000	0.0000

LOAD CASE Canopy Roof LL, Member Loads

Member	Type	Direction	Magnitude at Start (kips or kips-ft)	Magnitude at End (kips or kips-ft)	Start Position (x/L)	End Position from start (x/L)
200	Uniform Force	Global Z	-0.3200		0.0000	1.0000
201	Uniform Force	Global Z	-0.3200		0.0000	1.0000
202	Uniform Force	Global Z	-0.3200		0.0000	1.0000

	Project	Date
FIGG	FIU Pedestrian Bridge	10/04/16
	Project Number	Designed
	2262.03	ENH
	Description	Checked
	Canopy Beam Design	

South Plaza - Canopy Beam - Moment (k-ft)									
Member	Station	DC	Roof LL	WS 0° w/ Uplift	WS 0° (SER I)	STR I	STR III	SER I	SER III
201	0	23	2	-2	0	33	26	25	25
201	1	83	9	-8	0	119	93	91	90
201	2	137	14	-14	0	196	152	151	148
201	3	184	19	-18	0	264	205	203	200
201	4	225	23	-23	0	322	250	248	244
201	5	260	27	-26	0	372	288	286	281
201	6	288	30	-29	0	412	319	317	312
201	7	310	32	-31	0	442	343	341	335
201	8	325	33	-33	0	464	360	358	351
201	9	333	34	-34	0	476	370	368	361
201	10	336	34	-34	0	479	373	370	363
201	11	332	33	-33	0	473	368	365	358
201	12	321	32	-32	0	458	357	354	347
201	13	304	30	-30	0	433	338	335	328
201	14	281	28	-27	0	399	312	309	303
201	15	251	24	-24	1	356	280	276	270
201	16	214	20	-20	1	304	240	235	231
201	17	172	16	-16	1	242	193	188	184
201	18	122	11	-10	1	171	139	134	131
201	19	67	4	-4	1	91	77	72	70
201	20	5	-2	2	1	2	9	3	3

NOTE:

indicates maximum positive moment used for analysis

	Project	Date
FIGG	FIU Pedestrian Bridge	10/04/16
	Project Number	Designed
	2262.03	ENH
	Description	Checked
	Canopy Beam Design	

South Plaza - Canopy Beam - Shear (k)						
Member	Station	DC	Roof LL	WS 0° w/ Uplift	STR I	STR III
201	0	44	5	-5	62	48
201	1	39	4	-4	56	43
201	2	35	4	-4	50	38
201	3	30	3	-3	43	33
201	4	26	3	-3	37	29
201	5	21	2	-2	31	24
201	6	17	2	-2	24	19
201	7	13	1	-1	18	14
201	8	8	1	-1	12	9
201	9	4	0	0	5	4
201	10	-1	0	0	-1	-1
201	11	-5	-1	1	-7	-5
201	12	-9	-1	1	-14	-10
201	13	-14	-2	2	-20	-15
201	14	-18	-2	2	-26	-20
201	15	-23	-2	2	-33	-25
201	16	-27	-3	3	-39	-30
201	17	-32	-3	3	-45	-35
201	18	-36	-4	4	-52	-40
201	19	-40	-4	4	-58	-44
201	20	-45	-5	5	-64	-49

NOTE:

indicates maximum shear with concurrent torsion used for analysis

	Project	Date
FIGG	FIU Pedestrian Bridge	10/04/16
	Project Number	Designed
	2262.03	ENH
	Description	Checked
	Canopy Beam Design	

South Plaza - Canopy Beam - Torsion (k-ft)						
Member	Station	DC	Roof LL	WS 0° w/ Uplift	STR I	STR III
201	0	0	0	-9	-1	-14
201	1	0	0	-11	-1	-16
201	2	0	0	-13	-1	-19
201	3	0	0	-15	-1	-21
201	4	0	0	-17	-1	-24
201	5	0	0	-19	-1	-27
201	6	0	0	-20	-1	-29
201	7	0	0	-22	-1	-32
201	8	0	0	-24	-1	-34
201	9	0	0	-26	-1	-37
201	10	0	0	-28	-1	-40
201	11	0	0	-30	-1	-42
201	12	0	0	-32	-1	-45
201	13	0	0	-34	-1	-47
201	14	0	0	-35	-1	-50
201	15	0	0	-37	-1	-53
201	16	0	0	-39	-1	-55
201	17	0	0	-41	-1	-58
201	18	0	0	-43	-1	-61
201	19	0	0	-45	-1	-63
201	20	0	0	-47	-1	-66

NOTE:

indicates maximum torsion with concurrent shear used for analysis

Canopy Beam Positive Moment Design (Member 201, Station 10)

Input

$M_u := 479\text{kip}\cdot\text{ft}$ $\quad cover_{bot} := 2\text{in}$ $\quad f_c := 5.5\text{ksi}$

$M_s := 370\text{kip}\cdot\text{ft}$ $\quad d_{bar\_trans} := 0.625\text{in}$ $\quad f_y := 60\text{ksi}$

$h := 27\text{in}$ $\quad E_s := 29000\text{ksi}$

$b := 39\text{in}$ $\quad E_c := 3846\text{ksi}$

$$\beta_1 := \begin{cases} 0.85 & \text{if } f_c \le 4\text{ksi} \\ \max\left[0.85 - 0.05\cdot\left(\dfrac{f_c}{1000\text{psi}} - 4\right), 0.65\right] & \text{if } f_c > 4\text{ksi} \end{cases}$$

AASHTO 5.7.2.2

$\beta_1 = 0.775$

Strength Design

$BarSize_{bot} := 9$ $\quad d_{bar\_bot} := 1.128\text{in}$ $\quad A_{bar\_bot} := 1.00\text{in}^2$ $\quad N_{bar\_bot} := 6$ — Trial bar size

$s_{bot} := 6\text{in}$ — Spacing of reinforcement

$d := cover_{bot} + d_{bar\_trans} + 0.5\cdot d_{bar\_bot} = 3.189\cdot\text{in}$ — Distance from extreme tension fiber to centroid of reinforcement

$d_s := h - d = 23.81\cdot\text{in}$ — Effective depth of section

$A_{s\_prov} := N_{bar\_bot}\cdot A_{bar\_bot} = 6.00\cdot\text{in}^2$ — Area of steel provided

$a := \dfrac{A_{s\_prov}\cdot f_y}{0.85\cdot f_c\cdot b} = 1.97\cdot\text{in}$ — Depth of equivalent compression block

$c := \dfrac{a}{\beta_1} = 2.55\cdot\text{in}$ — Distance from extreme compression fiber to neutral axis

$d_t := h - cover_{bot} - d_{bar\_trans} - 0.5d_{bar\_bot} = 23.81\cdot\text{in}$ — Distance from extreme compression fiber to reinforcement layer closest to tension face

$\varepsilon_t := \dfrac{0.003\cdot(d_t - c)}{c} = 0.025$ — Net tensile strain in extreme tension steel

$$\phi_f := \begin{cases} 0.90 & \text{if } \varepsilon_t \ge 0.005 \\ \text{"Not tension controlled"} & \text{if } \varepsilon_t < 0.005 \end{cases}$$

$\phi_f = 0.90$ — Tension controlled resistance factor

$M_n := A_{s\_prov} \cdot f_y \cdot \left(d_s - \frac{a}{2}\right) = 685 \cdot ft \cdot kip$

$\phi M_n := \phi_f \cdot M_n$

$\phi M_n = 616 \cdot kip \cdot ft$ — Factored moment capacity of section

$Check1 := if(\phi M_n \geq M_u, "OK", "NG")$

$Check1 = "OK"$ $\frac{\phi M_n}{M_u} = 1.29$

Minimum Reinforcement Check (AASHTO 5.7.3.3.2)

$f_r := 0.24 \cdot \sqrt{f_c \cdot ksi} = 0.563 \cdot ksi$ — AASHTO 5.4.2.6

$I := \frac{b\,h^3}{12} = 3.08 \cdot ft^4$ — Moment of inertia at section checked

$c := \frac{h}{2} = 1.125 \cdot ft$

$\gamma_1 := 1.6$ — Flexural cracking variability factor for concrete structures other than precast segmental

$\gamma_3 := 0.67$ — For A615, Grade 60 Reinforcement

$M_{cr} := \frac{\gamma_3 \cdot \gamma_1 \cdot f_r \cdot I}{c} = 238 \cdot kip \cdot ft$

$Check2 := if(\phi M_n \geq min(M_{cr}, 1.33 \cdot M_u), "OK", "Add reinforcement")$

$Check2 = "OK"$

Crack Control Check (AASHTO 5.7.3.4)

$n := \frac{E_s}{E_c} = 7.5$ — Modular ratio

$A_s := N_{bar\_bot} \cdot A_{bar\_bot} = 6.00 \cdot in^2$ — Area of steel provided

$\rho := \frac{A_s}{b \cdot d_s} = 0.006$ — Reinforcement ratio

$k := \sqrt{(\rho \cdot n)^2 + 2 \cdot \rho \cdot n} - \rho \cdot n = 0.267$

$j := 1 - \frac{k}{3} = 0.911$

$f_{ss} := \frac{M_s}{A_s \cdot j \cdot d_s} = 34.1 \cdot ksi$

Tensile stress in rebar under service loads. Stress is limited to 0.6fy.

$Check3 := if(f_{ss} \leq 0.6 \cdot f_y, \text{"OK"}, \text{"NG"})$

$Check3 = \text{"OK"}$

$d_c := 2in + d_{bar\_trans} + \frac{d_{bar\_bot}}{2} = 3.19 \cdot in$

Thickness of concrete cover measured from extreme tension fiber to center of closest layer of flexural reinforcement

$\beta_s := 1 + \frac{d_c}{0.7 \cdot (h - d_c)} = 1.19$

$Exposure\_Class := 1$

$$\gamma_e := \begin{cases} 1.00 & \text{if } Exposure\_Class = 1 \\ 0.75 & \text{otherwise} \end{cases}$$

Exposure factor

$\gamma_e = 1.00$

$s_{max} := \frac{700 \cdot \gamma_e}{\beta_s \cdot f_{ss} \cdot \frac{in}{kip}} - 2 \cdot d_c = 10.84 \cdot in$

Maximum spacing of reinforcement for crack control (AASHTO 5.7.3.4-1)

$Check4 := if(s_{bot} \leq s_{max}, \text{"OK"}, \text{"NG"})$

$Check4 = \text{"OK"}$

Shrinkage and Temperature Reinforcement (AASHTO 5.10.8)

$A_{bar\_t\_sh} := 0.20in^2$ $s_{t\_sh} := 12in$

$A_{s\_t\_sh} := max\left[\frac{1.30 \cdot \frac{kip}{in} \cdot b \cdot h}{2 \cdot (b + h) \cdot f_y \cdot ft}, 0.11 \frac{in^2}{ft}\right] = 0.17 \cdot \frac{in^2}{ft}$

$A_{s\_t\_sh\_prov} := \frac{A_{bar\_t\_sh} \cdot 12 \frac{in}{ft}}{s_{t\_sh}} = 0.20 \cdot \frac{in^2}{ft}$

$Check5 := if(A_{s\_t\_sh\_prov} \geq A_{s\_t\_sh}, \text{"OK"}, \text{"NG"})$

$Check5 = \text{"OK"}$

Canopy Beam Shear (with Concurrent Torsion) Design (Beam 201, Station 20)

Input

$d_s := 23.81in$

$h := 27in$

$f_c := 5.5ksi$

$b := 39in$

$f_y := 60ksi$

$A_{s\_prov} := 6.00in^2$

$\phi_f := 0.9$

$M_n := 685\ ft \cdot kip$

$A_{bar\_trans} := 0.31in^2$

$\phi_v := 0.9$

$A_{cp} := 1206in^2$

(Actual area and perimeter calculated)

$M_u := 2\ ft \cdot kip$

$n_{legs} := 2$

$\theta := 45deg$

$p_c := 144in$

$V_u := 64kip$

$s_{trans} := 9in$

$\beta := 2$

$p_h := 125in$

$T_u := 1 ft \cdot kip$

Minimum Transverse Reinforcement Check (AASHTO 5.8.2.5)

$$A_{v\_min} := 0.0316 \cdot \sqrt{f_c \cdot ksi} \cdot \frac{b \cdot s_{trans}}{f_y} = 0.43 \cdot in^2$$

$$A_{v\_prov} := n_{legs} A_{bar\_trans} = 0.62 \cdot in^2$$

$$Check1 := if\left(A_{v\_prov} \geq A_{v\_min}, "OK", "NG"\right)$$

$$Check1 = "OK"$$

Shear Design (AASHTO 5.8.3.3)

$$d_v := max\left(0.72 \cdot h, 0.9d_s, \frac{M_n}{A_{s\_prov} \cdot f_y}\right) = 22.83 \cdot in$$

Effective shear depth

$$V_c := 0.0316 \cdot \beta \cdot \sqrt{f_c \cdot ksi} \cdot b \cdot d_v = 132 \cdot kip$$

Nominal shear resistance provided by concrete

$$Check2 := if\left(V_u > 0.5 \cdot \phi_v\ V_c, "Consider\ Shear", "Provide\ Min.\ Reinf."\right)$$

AASHTO LRFD Eq. 5.8.2.4-1

$$Check2 = "Consider\ Shear"$$

$$V_s := \frac{A_{v\_prov} \cdot f_y \cdot d_v}{\tan(\theta) \cdot s_{trans}} = 94 \cdot kip$$

Nominal shear resistance provided by shear reinforcement

$$V_n := min\left(V_c + V_s, 0.25 \cdot f_c \cdot b \cdot d_v\right) = 226 \cdot kip$$

Nominal shear resistance

$$\phi V_n := \phi_v \cdot V_n = 204 \cdot kip$$

Factored shear resistance

$\text{Check3} := \text{if}\left(V_u \le \phi V_n, \text{"OK"}, \text{"NG"}\right)$

$\text{Check3} = \text{"OK"}$ $\qquad \dfrac{\phi V_n}{V_u} = 3.18$

Combined Shear and Torsion Check (AASHTO 5.8.3.6)

$T_{cr} := 0.125 \cdot \sqrt{f_c \cdot ksi} \cdot \dfrac{A_{cp}^{\,2}}{p_c} = 247 \cdot ft \cdot kip$ Torsional cracking moment

$\text{Check4} := \text{if}\left(T_u > 0.25 \cdot \phi_v\, T_{cr}, \text{"Consider Torsion"}, \text{"Neglect Torsion"}\right)$ AASHTO LRFD Eq. 5.8.2.1-3

$\text{Check4} = \text{"Neglect Torsion"}$

Canopy Beam Torsion (with Concurrent Shear) Design (Beam 201, Station 20)

Input

$d_s := 23.81in$ $h := 27in$ $f_c := 5.5ksi$

$b := 39in$ $f_y := 60ksi$

$A_{s\_prov} := 6.00in^2$ $\phi_f := 0.9$

$M_n := 685\ ft\cdot kip$ $A_{bar\_trans} := 0.31in^2$ $\phi_v := 0.9$ $A_{cp} := 1206in^2$ (Actual area and perimeter calculated)

$M_u := 9\ ft\cdot kip$ $n_{legs} := 2$ $\theta := 45deg$ $p_c := 144in$

$V_u := 49kip$ $s_{trans} := 9in$ $\beta := 2$ $p_h := 125in$

$T_u := 66ft\cdot kip$

Minimum Transverse Reinforcement Check (AASHTO 5.8.2.5)

$$A_{v\_min} := 0.0316\cdot\sqrt{f_c\cdot ksi}\cdot\frac{b\cdot s_{trans}}{f_y} = 0.43\cdot in^2$$

$$A_{v\_prov} := n_{legs}A_{bar\_trans} = 0.62\cdot in^2$$

$$Check1 := if\left(A_{v\_prov} \geq A_{v\_min}, \text{"OK"}, \text{"NG"}\right)$$

$$Check1 = \text{"OK"}$$

Shear Design (AASHTO 5.8.3.3)

$$d_v := max\left(0.72\cdot h, 0.9d_s, \frac{M_n}{A_{s\_prov}\cdot f_y}\right) = 22.83\cdot in$$ Effective shear depth

$$V_c := 0.0316\cdot\beta\cdot\sqrt{f_c\cdot ksi}\cdot b\cdot d_v = 132\cdot kip$$ Nominal shear resistance provided by concrete

$$Check2 := if\left(V_u > 0.5\cdot\phi_v V_c, \text{"Consider Shear"}, \text{"Provide Min. Reinf."}\right)$$ AASHTO LRFD Eq. 5.8.2.4-1

$$Check2 = \text{"Provide Min. Reinf."}$$

$$V_s := \frac{A_{v\_prov}\cdot f_y\cdot d_v}{\tan(\theta)\cdot s_{trans}} = 94\cdot kip$$ Nominal shear resistance provided by shear reinforcement

$$V_n := min\left(V_c + V_s, 0.25\cdot f_c\cdot b\cdot d_v\right) = 226\cdot kip$$ Nominal shear resistance

$$\phi V_n := \phi_v\cdot V_n = 204\cdot kip$$ Factored shear resistance

$Check3 := if\left(V_u \le \phi V_n, "OK", "NG"\right)$

$Check3 = "OK"$ $\quad \dfrac{\phi V_n}{V_u} = 4.16$

Combined Shear and Torsion Check (AASHTO 5.8.3.6)

$T_{cr} := 0.125 \cdot \sqrt{f_c \cdot ksi} \cdot \dfrac{A_{cp}^{\,2}}{p_c} = 247 \cdot ft \cdot kip$ Torsional cracking moment

$Check4 := if\left(T_u > 0.25 \cdot \phi_v\, T_{cr}, "Consider Torsion", "Neglect Torsion"\right)$ AASHTO LRFD Eq. 5.8.2.1-3

$Check4 = "Consider Torsion"$

$A_v := if\left[Check2 = "Provide Min. Reinf.", A_{v\_min}, \dfrac{\left(\dfrac{V_u}{\phi_v} - V_c\right) \cdot s_{trans} \cdot \tan(\theta)}{f_y \cdot d_v}\right] = 0.43 \cdot in^2$ Area of shear reinforcement required

$A_{oh} := 884in^2$ Area enclosed by centerline of transverse torsion reinforcement

$A_o := 0.85 \cdot A_{oh} = 751 \cdot in^2$ Area enclosed by shear flow path. Approximated per ACI 11.5.3.5.

$A_t := if\left(Check4 = "Consider Torsion", \dfrac{T_u \cdot \tan(\theta) \cdot s_{trans}}{\phi_v \cdot 2 \cdot A_o \cdot f_y}, 0in^2\right) = 0.09 \cdot in^2$ Area of one leg of closed transverse torsion reinforcement required

$A_{tot} := 2A_t + A_v = 0.61 \cdot in^2$

$Check5 := if\left(A_{v\_prov} \ge A_{tot}, "OK", "NG"\right)$ AASHTO LRFD 5.8.3.6.1

$Check5 = "OK"$

Check Longitudinal Reinforcement (AASHTO 5.8.3.6.3)

$V_{s1} := if\left(V_s > \dfrac{V_u}{\phi_v}, \dfrac{V_u}{\phi_v}, V_s\right) = 54 \cdot kip$ AASHTO LRFD 5.8.3.5

$Check6 := if\left[A_{s\_prov} \cdot f_y \ge \dfrac{M_u}{\phi_f \cdot d_v} + \sqrt{\left(\dfrac{V_u}{\phi_v} - 0.5 \cdot V_{s1}\right)^2 + \left(\dfrac{0.45 \cdot p_h \cdot T_u}{2 \cdot A_o \cdot \phi_v}\right)^2}, "OK", "NG"\right]$ AASHTO LRFD Eq. 5.8.3.6.3-1

$Check6 = "OK"$

	Project	Date
FIGG	FIU Pedestrian Bridge	08/20/16
	Project Number	Designed
	2262.03	ENH
	Description	Checked
	1.75'x2.5' Canopy Support Column Design	

Min. column reinf. per ACI 318-11 10.9.1: 10-#10

A_g (in^2)	630	
$A_{s,min}$ (in^2)	6.30	
$A_{s,prov}$ (in^2)	**12.70**	OK

Lap Splice Length per AASHTO LRFD 5.11.5.3.1: 69 in

% Spliced	100%
Class	C
A_b (in^2)	1.27
d_b (in)	1.27
l_{db} (in)	40.61
$1.7l_d$ (in)	69

FIGG	Project: FIU PEDESTRIAN BRIDGE	Date: 8/20/16	Page / Of
	Project Number: 2262.03	Designed: ENH	
	Description: 1.75' x 2.5' COLUMN DESIGN	Checked:	

TRANSVERSE DESIGN

From Strength load combinations : Max F_x = 31 Kips
Max F_y = 6 Kips

F_x Shear :

$d_v = 0.72h = 0.72(30\text{ in}) = 21.6\text{ in}$

Provide minimum reinforcement per AASHTO LRFD Section 5.8.2.5 :

$$\frac{A_{v,min}}{S} = \frac{0.0316\sqrt{f'_c}\,b_v}{f_y} = \frac{0.0316\sqrt{5.5}(21\text{ in})(12\text{ in/ft})}{60\text{ Ksi}} = 0.31\ \frac{\text{in}^2}{\text{ft}}$$

Try #5 @ 12" :

$$\frac{A_v}{S} = \frac{2\text{ legs}(0.31\text{ in}^2)}{1\text{ ft}} = 0.62\ \frac{\text{in}^2}{\text{ft}} > 0.31\ \frac{\text{in}^2}{\text{ft}}\quad \text{OK}$$

Use $\beta = 2.0$ and $\theta = 45°$ for nonprestressed sections not subjected to axial tension per AASHTO LRFD Section 5.8.3.4.1.

$V_c = 0.0316\,\beta\sqrt{f'_c}\,b_v d_v = 0.0316(2.0)\sqrt{5.5}(21\text{ in})(21.6\text{ in}) = 67\text{ Kips}$

$0.5\,\phi\,V_c = 0.5(0.9)(67\text{ Kips}) = 30\text{ Kips} \approx 31\text{ Kips} \longrightarrow$ Say OK

Min. reinforcement only per Eq. 5.8.2.4-1.

F_y Shear :

$d_v = 0.72h = 0.72(21\text{ in}) = 15.1\text{ in}$

Check minimum reinforcement :

$$\frac{A_{v,min}}{S} = \frac{0.0316\sqrt{5.5}(30\text{ in})(12\text{ in/ft})}{60\text{ Ksi}} = 0.44\text{ in}^2/\text{ft}$$

$$\frac{A_{v,prov}}{S} = \frac{2\text{ legs}(0.31\text{ in}^2)}{1\text{ ft}} = 0.62\text{ in}^2/\text{ft} > 0.44\text{ in}^2/\text{ft}\quad \text{OK}$$

$V_c = 0.0316(2)\sqrt{5.5}(30\text{ in})(15.1\text{ in}) = 67\text{ Kips}$

$0.5\,\phi\,V_c = 0.5(0.9)(67\text{ Kips}) = 30\text{ Kips} > 6\text{ Kips} \longrightarrow$ Min. reinforcement only per Eq. 5.8.2.4-1.

Moment Magnification Factor - Transverse (Mx)

Input

$l_u := 14.67\text{ft}$ $\quad E_c := 3846\text{ksi}$ $\quad P_{DC} := 60.2\text{kip}$ $\quad M_{DC} := -0.2\text{kip}\cdot\text{ft}$

$k := 2.1$ $\quad I_g := 1.12\text{ft}^4$ $\quad P_{WS} := 0\text{kip}$ $\quad M_{WS} := 35.3\text{kip}\cdot\text{ft}$

$h := 1.75\text{ft}$ $\quad C_m := 1.0$

$\phi_K := 0.75$

Check Slenderness (AASHTO LRFD 5.7.4.3)

$$\lambda := \frac{(k\cdot l_u)}{0.3\cdot h} = 58.68$$

Check1 := if(λ > 22, "Consider Slenderness" , "Neglect Slenderness")

Check1 = "Consider Slenderness"

Determine EI (AASHTO LRFD 5.7.4.3)

$$M_{TOT} := 0.9M_{DC} + 1.4M_{WS} = 49\cdot\text{ft}\cdot\text{kip}$$

$$M_{PERM} := 0.9M_{DC} = -0\cdot\text{ft}\cdot\text{kip}$$

$$\beta_d := \frac{|M_{PERM}|}{|M_{TOT}|} = 3.656\times10^{-3}$$

$$EI := \frac{0.4E_c\cdot I_g}{1+\beta_d} = 3.56\times10^{7}\cdot\text{kip}\cdot\text{in}^2$$

Determine Euler Buckling Load (AASHTO LRFD 4.5.3.2.2b)

$$P_e := \frac{\pi^2\cdot EI}{(k\cdot l_u)^2} = 2571\cdot\text{kip}$$

Determine Moment Magnification Factors (AASHTO LRFD 4.5.3.2.2b)

$$P_u := 0.9P_{DC} + 1.4P_{WS} = 54\cdot\text{kip}$$

$$\delta_b := \frac{C_m}{1-\dfrac{P_u}{\phi_K\cdot P_e}} = 1.03$$

$$\delta_s := \delta_b = 1.03$$

Moment Magnification Factor - Longitudinal (My)

Input

$l_u := 14.67ft$ $E_c := 3846ksi$ $P_{DC} := 60.2kip$ $M_{DC} := 312.2kip \cdot ft$

$k := 2.1$ $I_g := 2.28ft^4$ $P_{LL} := 4.7kip$ $M_{LL} := 24.9kip \cdot ft$

$h := 2.5ft$ $C_m := 1.0$

$\phi_K := 0.75$

Check Slenderness (AASHTO LRFD 5.7.4.3)

$$\lambda := \frac{(k \cdot l_u)}{0.3 \cdot h} = 41.08$$

Check1 := if(λ > 22,"Consider Slenderness" ,"Neglect Slenderness")

Check1 = "Consider Slenderness"

Determine EI (AASHTO LRFD 5.7.4.3)

$$M_{TOT} := 1.25M_{DC} + 1.75M_{LL} = 434 \cdot ft \cdot kip$$

$$M_{PERM} := 1.25M_{DC} = 390 \cdot ft \cdot kip$$

$$\beta_d := \frac{|M_{PERM}|}{|M_{TOT}|} = 0.90$$

$$EI := \frac{0.4E_c \cdot I_g}{1 + \beta_d} = 3.829 \times 10^7 \cdot kip \cdot in^2$$

Determine Euler Buckling Load (AASHTO LRFD 4.5.3.2.2b)

$$P_e := \frac{\pi^2 \cdot EI}{(k \cdot l_u)^2} = 2765 \cdot kip$$

Determine Moment Magnification Factors (AASHTO LRFD 4.5.3.2.2b)

$$P_u := 1.25P_{DC} + 1.75P_{LL} = 83 \cdot kip$$

$$\delta_b := \frac{C_m}{1 - \frac{P_u}{\phi_K \cdot P_e}} = 1.04$$

$$\delta_s := \delta_b = 1.04$$

	Project	Date
FIGG	FIU Pedestrian Bridge	08/20/16
	Project Number	Designed
	2262.03	ENH
	Description	Checked
	1.75'x2.5' Canopy Column Design (Bot of Col)	

Moment Magnification Factor per AASHTO LRFD 4.5.3.2.2b:

δ	1.03	1.04

Canopy LL				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	211	4.7	0.0	24.9

Canopy LL		
Fz (k)	Mx (k-ft)	My (k-ft)
4.7	0.0	25.9

DC (Total)				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	211	60.2	-0.2	312.2

DC (Total)		
Fz (k)	Mx (k-ft)	My (k-ft)
60.2	-0.2	324.7

WS_0 DEG				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	211	0.0	35.3	0.8

WS_0 DEG		
Fz (k)	Mx (k-ft)	My (k-ft)
0.0	36.4	0.8

WS_0 DEG_SRVI				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	211	0.0	24.5	1.9

WS_0 DEG_SRVI		
Fz (k)	Mx (k-ft)	My (k-ft)
0.0	25.2	2.0

WS_0 DEG_STRV				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	211	0.0	23.9	1.8

WS_0 DEG_STRV		
Fz (k)	Mx (k-ft)	My (k-ft)
0.0	24.6	1.9

WS_0 DEG_WEST				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	211	0.0	-17.9	0.3

WS_0 DEG_WEST		
Fz (k)	Mx (k-ft)	My (k-ft)
0.0	-18.4	0.3

WS_0 DEG_WEST_SRVI				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	211	0.0	-12.7	1.4

WS_0 DEG_WEST_SRVI		
Fz (k)	Mx (k-ft)	My (k-ft)
0.0	-13.1	1.5

WS_0 DEG_WEST_STRV				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	211	0.0	-12.4	1.4

WS_0 DEG_WEST_STRV		
Fz (k)	Mx (k-ft)	My (k-ft)
0.0	-12.8	1.5

WS_0 DEG_WEST+WUP				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	211	-10.6	-17.7	-54.8

WS_0 DEG_WEST+WUP		
Fz (k)	Mx (k-ft)	My (k-ft)
-10.6	-18.2	-57.0

	Project	Date
FIGG	FIU Pedestrian Bridge	08/20/16
	Project Number	Designed
	2262.03	ENH
	Description	Checked
	1.75'x2.5' Canopy Column Design (Bot of Col)	

Moment Magnification Factor per AASHTO LRFD 4.5.3.2.2b:

δ	1.03	1.04

WS_0 DEG+WUP				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	211	-10.6	35.0	-55.5

WS_0 DEG+WUP		
Fz (k)	Mx (k-ft)	My (k-ft)
-10.6	36.1	-57.7

WS_90 DEG				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	211	0.5	-0.1	-16.9

WS_90 DEG		
Fz (k)	Mx (k-ft)	My (k-ft)
0.5	-0.1	-17.6

WS_90 DEG_SRVI				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	211	0.4	-0.1	-19.2

WS_90 DEG_SRVI		
Fz (k)	Mx (k-ft)	My (k-ft)
0.4	-0.1	-20.0

WS_90 DEG_STRV				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	211	0.3	-0.1	-18.7

WS_90 DEG_STRV		
Fz (k)	Mx (k-ft)	My (k-ft)
0.3	-0.1	-19.4

XTRACT Section Report

FIGG
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FIU pedestrian Bridge
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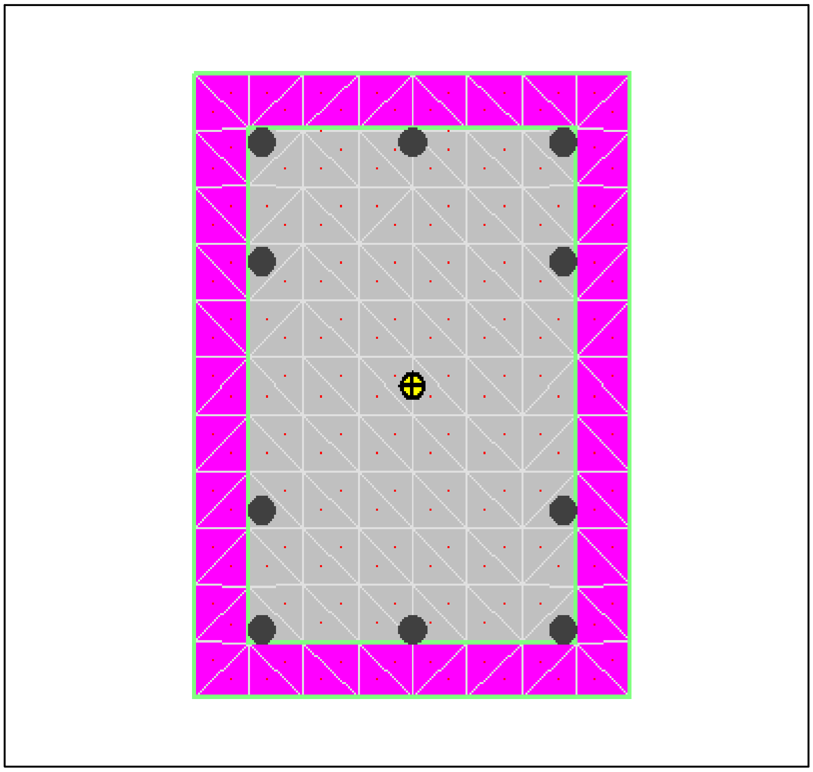
Section Name: Bent Column

Section Details:

X Centroid:	1.95E-16 ft
Y Centroid:	-2.65E-17 ft
Section Area:	4.375 ft^2
EI gross about X:	1.590E+6 kip-ft^2
EI gross about Y:	764.2E+3 kip-ft^2
I trans (Confined1) about X:	2.611 ft^4
I trans (Confined1) about Y:	1.255 ft^4
Reinforcing Bar Area:	87.97E-3 ft^2
Percent Longitudinal Steel:	2.011 %
Overall Width:	1.750 ft
Overall Height:	2.500 ft
Number of Fibers:	196
Number of Bars:	10
Number of Materials:	3



Material Types and Names:

Unconfined Concrete:	Unconfined1
Confined Concrete:	Confined1
Strain Hardening Steel:	Steel1

Comments:

User Comments

Service III check performed using XTRACT. This is not a bridge column; therefore, 28 ksi stress in longitudinal reinforcing steel is acceptable per ACI 318-14 Section 24.3.2.1.

XTRACT Material Report

FIGG
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FIU pedestrian Bridge
FIU
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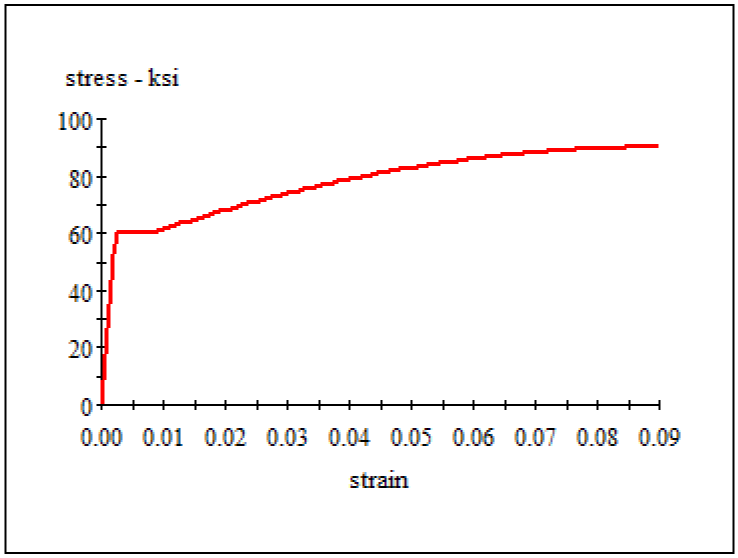
Material Name: Steel1

Material Type: Strain Hardening Steel

Input Parameters:

Yield Stress:	60.00 ksi
Fracture Stress:	90.00 ksi
Yield Strain:	2.069E-3
Strain at Strain Hardening:	8.000E-3
Failure Strain:	90.00E-3
Elastic Modulus:	29.00E+3 ksi
Additional Information:	Symetric Tension and Comp.



Model Details:

For Strain - $\varepsilon < \varepsilon_y$ $\quad fs = E \cdot \varepsilon$

For Strain - $\varepsilon < \varepsilon_{sh}$ $\quad fs = f_y$

For Strain - $\varepsilon < \varepsilon_{su}$ $\quad fs = f_u - (f_u - f_y) \cdot \left(\dfrac{\varepsilon_{su} - \varepsilon}{\varepsilon_{su} - \varepsilon_{sh}} \right)^2$

ε = Steel Strain

fs = Steel Stress

f_y = Yield Stress

f_u = Fracture Stress

ε_y = Yield Strain

ε_{sh} = Strain at Strain Hardening

ε_{su} = Failure Strain

E = Elastic Modulus

Material Color States:

- Tension force after onset of strain hardening
- Tension force after yield
- Initial state
- Compression force after yield
- Compression force after onset of strain hardening

XTRACT Analysis Report

FIGG
FIGG
9/30/2016
FIU pedestrian Bridge
FIU
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Section Name:	Bent Column
Loading Name:	service III
Analysis Type:	Moment Curvature

Section Details:

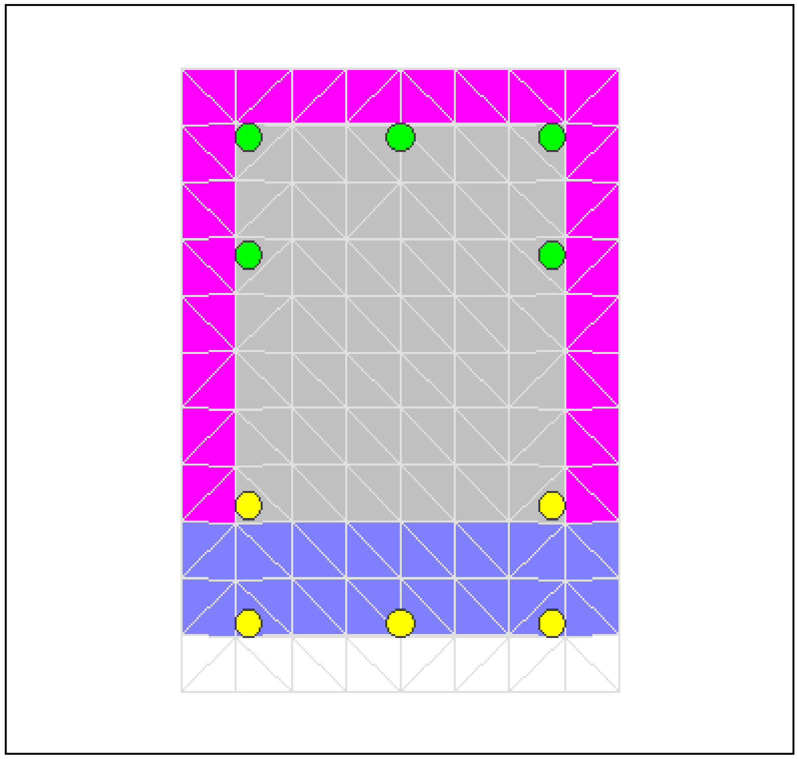
X Centroid:	1.95E-16 ft
Y Centroid:	-2.65E-17 ft
Section Area:	4.375 ft^2

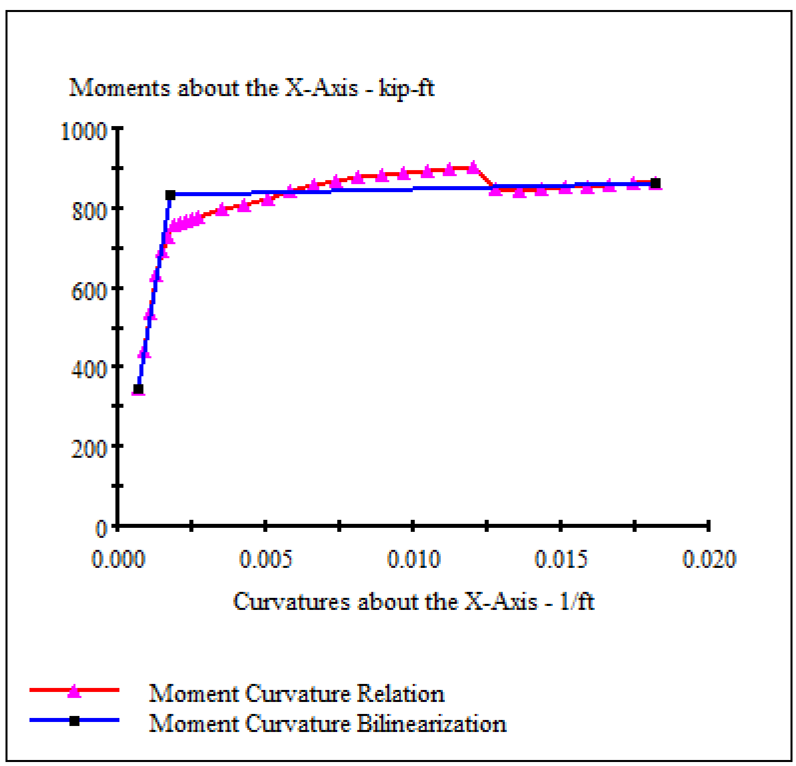
Loading Details:

Constant Load - P:	64.00 kips
Constant Load - Mxx:	-345.4 kip-ft
Constant Load - Myy:	-.2000 kip-ft
Incrementing Loads:	Mxx Only
Number of Points:	31
Analysis Strategy:	Displacement Control

Analysis Results:

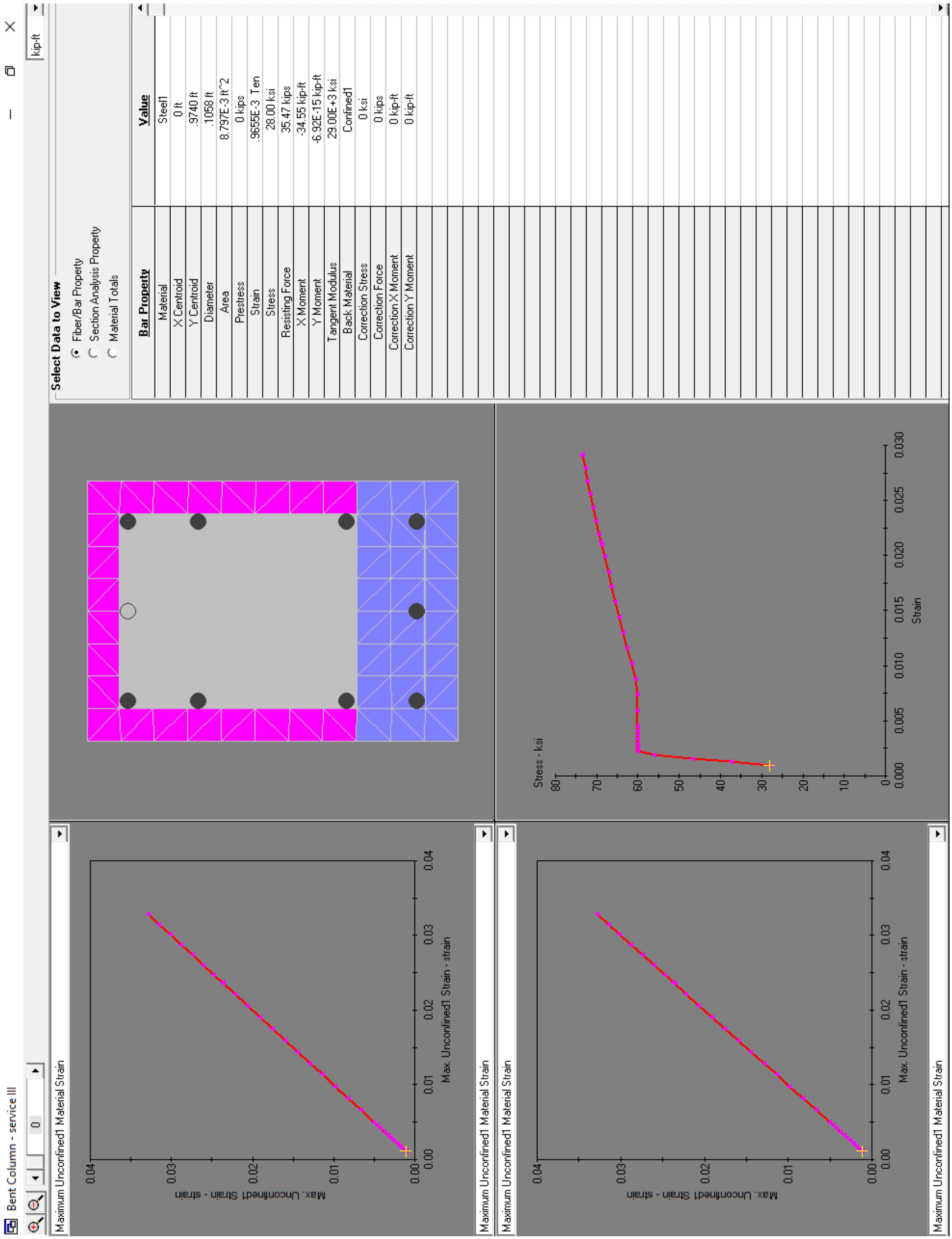
Failing Material:	Confined1
Failure Strain:	7.273E-3 Compression
Curvature at Initial Load:	.6527E-3 1/ft
Curvature at First Yield:	1.354E-3 1/ft
Ultimate Curvature:	18.20E-3 1/ft
Moment at First Yield:	657.5 kip-ft
Ultimate Moment:	866.8 kip-ft
Centroid Strain at Yield:	.7491E-3 Ten
Centroid Strain at Ultimate:	11.44E-3 Ten
N.A. at First Yield:	.5531 ft
N.A. at Ultimate:	.6288 ft
Energy per Length:	14.65 kips
Effective Yield Curvature:	1.756E-3 1/ft
Effective Yield Moment:	836.0 kip-ft
Over Strength Factor:	1.037
EI Effective:	444.7E+3 kip-ft^2
Yield EI Effective:	1876 kip-ft^2
Bilinear Harding Slope:	.4220 %
Curvature Ductility:	10.37





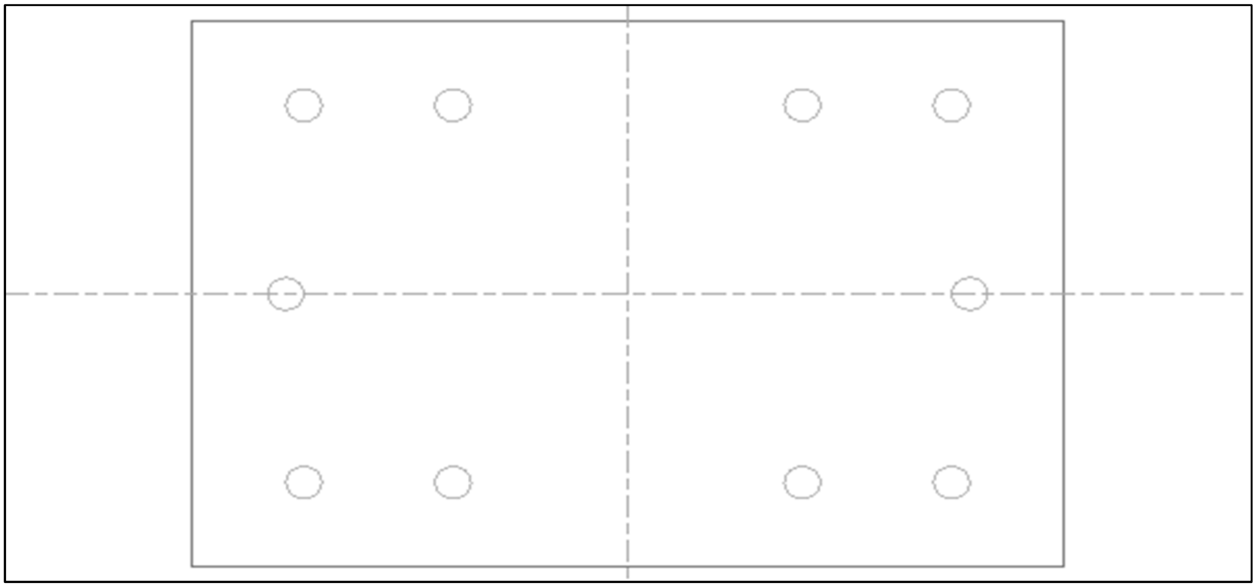
Comments:

User Comments



Bent Column - service III
kip-ft
Maximum Unconfined1 Material Strain
Max. Unconfined1 Strain - strain
Select Data to View
Fiber/Bar Property
Section Analysis Property
Material Totals
Bar Property
Value
Material
Steel1
X Centroid
0 ft
Y Centroid
.9740 ft
Diameter
.1058 ft
Area
8.797E-3 ft^2
Prestress
0 kips
Strain
.9655E-3 Ten
Stress
28.00 ksi
Resisting Force
35.47 kips
X Moment
-34.55 kip-ft
Y Moment
-6.92E-15 kip-ft
Tangent Modulus
29.00E+3 ksi
Back Material
Confined1
Correction Stress
0 ksi
Correction Force
0 kips
Correction X Moment
0 kip-ft
Correction Y Moment
0 kip-ft
Stress - ksi
Strain

Section ID: Cross Section 2



Material Properties

f'c (ksi)=	5.5	Strain @ Ult.=	0.003
f''c (ksi)=	4.96	Strain @ Max.=	0.0024
fy (ksi)=	60	E Conc. (ksi)=	3846
fr (ksi)=	0.563	E Rebar (ksi)=	29000
Tendon fpu (ksi)=	270	E Tendon (ksi)=	28500
PT Bar fpu (ksi)=	150	E PT Bar (ksi)=	30000
Gamma =	0.15		

Section Properties

Ix (in^4)=	23150	Iy (in^4)=	47245
Y top (in)=	10.4997	X lft (in)=	14.9996
Y bot (in)=	10.4997	X rgt (in)=	14.9996
Area (in^2)=	629.97	Ixy (in^4)=	0

Cross Section Coordinates

** Exterior Boundary Coordinates **

Point No.	X (in)	Y (in)	Point No.	X (in)	Y (in)
1	-15	10.5	2	15	10.5
3	15	-10.5	4	-15	-10.5

Rebar Information

Bar No.	X (in)	Y (in)	Dia. (in)	Area (in^2)
1	-11.75	0	1.25	1.23
2	11.12	7.25	1.25	1.23
3	-6	7.25	1.25	1.23
4	-11.12	7.25	1.25	1.23
5	-6	-7.25	1.25	1.23
6	-11.12	-7.25	1.25	1.23
7	11.12	-7.25	1.25	1.23
8	11.75	0	1.25	1.23
9	6	7.25	1.25	1.23
10	6	-7.25	1.25	1.23

1.75'x2.5' Canopy Support Column - South Plaza - Bottom of Column - Strength I								
Section, Member & Joint	**STR 1 Results**	**Combo ID**	**Pu (kips)**	**Mux (ft*kip)**	**Muy (ft*kip)**	**Mu (ft*kip)**	**ϕMn (ft*kip)**	**ϕMn/Mu**
	Max P	STR 1/ 1	83.5	-0.3	451.2	451.2	730.5	1.619
Section ID	Max Mx	STR 1/ 2	62.4	-0.2	337.6	337.6	713.8	2.115
Cross Section 2	Max My	STR 1/ 1	83.5	-0.3	451.2	451.2	730.5	1.619
Member	Max M	STR 1/ 1	83.5	-0.3	451.2	451.2	730.5	1.619
212	Min P	STR 1/ 2	62.4	-0.2	337.6	337.6	713.8	2.115
Joint	Min Mx	STR 1/ 1	83.5	-0.3	451.2	451.2	730.5	1.619
211	Min My	STR 1/ 2	62.4	-0.2	337.6	337.6	713.8	2.115
	Min M	STR 1/ 2	62.4	-0.2	337.6	337.6	713.8	2.115

MIN C/D =	**1.619**
CHECK	**OK**

1.75'x2.5' Canopy Support Column - South Plaza - Bottom of Column - Strength III								
Section, Member & Joint	**STR 3 Results**	**Combo ID**	**Pu (kips)**	**Mux (ft*kip)**	**Muy (ft*kip)**	**Mu (ft*kip)**	**ϕMn (ft*kip)**	**ϕMn/Mu**
	Max P	STR 3/ 5	76.0	-0.4	381.2	381.2	724.6	1.901
Section ID	Max Mx	STR 3/ 6	54.2	50.8	293.4	297.7	687.1	2.308
Cross Section 2	Max My	STR 3/ 1	75.3	50.7	407.0	410.1	709.1	1.729
Member	Max M	STR 3/ 1	75.3	50.7	407.0	410.1	709.1	1.729
212	Min P	STR 3/ 8	39.3	-25.7	212.4	214.0	681.6	3.185
Joint	Min Mx	STR 3/ 2	75.3	-26.0	406.3	407.1	717.8	1.763
211	Min My	STR 3/ 9	39.3	50.4	211.5	217.4	669.8	3.081
	Min M	STR 3/ 8	39.3	-25.7	212.4	214.0	681.6	3.185

MIN C/D =	**1.729**
CHECK	**OK**

1.75'x2.5' Canopy Support Column - South Plaza - Bottom of Column - Strength V								
Section, Member & Joint	**STR 5 Results**	**Combo ID**	**Pu (kips)**	**Mux (ft*kip)**	**Muy (ft*kip)**	**Mu (ft*kip)**	**ϕMn (ft*kip)**	**ϕMn/Mu**
	Max P	STR 5/ 3	81.7	-0.3	433.1	433.1	729.1	1.684
Section ID	Max Mx	STR 5/ 4	60.5	9.7	328.0	328.1	710.7	2.166
Cross Section 2	Max My	STR 5/ 1	81.6	9.6	441.6	441.7	727.8	1.648
Member	Max M	STR 5/ 1	81.6	9.6	441.6	441.7	727.8	1.648
212	Min P	STR 5/ 4	60.5	9.7	328.0	328.1	710.7	2.166
Joint	Min Mx	STR 5/ 2	81.6	-5.4	441.4	441.5	728.7	1.651
211	Min My	STR 5/ 6	60.6	-0.2	319.4	319.4	712.4	2.230
	Min M	STR 5/ 6	60.6	-0.2	319.4	319.4	712.4	2.230

MIN C/D =	**1.648**
CHECK	**OK**

Moment Magnification Factor - Transverse (Mx)

Input

$l_u := 14.67ft$

$k := 2.1$

$h := 1.75ft$

$E_c := 3846ksi$

$I_g := 1.12ft^4$

$C_m := 1.0$

$\phi_K := 0.75$

$P_{DC} := 50.6kip$

$P_{WS} := -10.6kip$

$M_{DC} := 0.4kip \cdot ft$

$M_{WS} := 15kip \cdot ft$

Check Slenderness (AASHTO LRFD 5.7.4.3)

$$\lambda := \frac{(k \cdot l_u)}{0.3 \cdot h} = 58.68$$

Check1 := if(λ > 22, "Consider Slenderness", "Neglect Slenderness")

Check1 = "Consider Slenderness"

Determine EI (AASHTO LRFD 5.7.4.3)

$$M_{TOT} := 1.25M_{DC} + 1.4M_{WS} = 22 \cdot ft \cdot kip$$

$$M_{PERM} := 1.25M_{DC} = 1 \cdot ft \cdot kip$$

$$\beta_d := \frac{|M_{PERM}|}{|M_{TOT}|} = 0.023$$

$$EI := \frac{0.4E_c \cdot I_g}{1 + \beta_d} = 3.492 \times 10^7 \cdot kip \cdot in^2$$

Determine Euler Buckling Load (AASHTO LRFD 4.5.3.2.2b)

$$P_e := \frac{\pi^2 \cdot EI}{(k \cdot l_u)^2} = 2522 \cdot kip$$

Determine Moment Magnification Factors (AASHTO LRFD 4.5.3.2.2b)

$$P_u := 1.25P_{DC} + 1.4P_{WS} = 48 \cdot kip$$

$$\delta_b := \frac{C_m}{1 - \frac{P_u}{\phi_K \cdot P_e}} = 1.03$$

$$\delta_s := \delta_b = 1.03$$

Moment Magnification Factor - Longitudinal (My)

Input

$l_u := 14.67\text{ft}$ $\quad E_c := 3846\text{ksi}$ $\quad P_{DC} := 50.6\text{kip}$ $\quad M_{DC} := 13.3\text{kip}\cdot\text{ft}$

$k := 2.1$ $\quad I_g := 2.28\text{ft}^4$ $\quad P_{WS} := -10.6\text{kip}$ $\quad M_{WS} := 6.9\text{kip}\cdot\text{ft}$

$h := 2.5\text{ft}$ $\quad C_m := 1.0$

$\phi_K := 0.75$

Check Slenderness (AASHTO LRFD 5.7.4.3)

$$\lambda := \frac{(k\cdot l_u)}{0.3\cdot h} = 41.08$$

Check1 := if(λ > 22, "Consider Slenderness" , "Neglect Slenderness")

Check1 = "Consider Slenderness"

Determine EI (AASHTO LRFD 5.7.4.3)

$$M_{TOT} := 1.25M_{DC} + 1.40M_{WS} = 26\cdot\text{ft}\cdot\text{kip}$$

$$M_{PERM} := 1.25M_{DC} = 17\cdot\text{ft}\cdot\text{kip}$$

$$\beta_d := \frac{|M_{PERM}|}{|M_{TOT}|} = 0.63$$

$$EI := \frac{0.4E_c\cdot I_g}{1 + \beta_d} = 4.455 \times 10^7\cdot\text{kip}\cdot\text{in}^2$$

Determine Euler Buckling Load (AASHTO LRFD 4.5.3.2.2b)

$$P_e := \frac{\pi^2\cdot EI}{(k\cdot l_u)^2} = 3217\cdot\text{kip}$$

Determine Moment Magnification Factors (AASHTO LRFD 4.5.3.2.2b)

$$P_u := 1.25P_{DC} + 1.40P_{WS} = 48\cdot\text{kip}$$

$$\delta_b := \frac{C_m}{1 - \frac{P_u}{\phi_K\cdot P_e}} = 1.02$$

$$\delta_s := \delta_b = 1.02$$

	Project	Date
FIGG	FIU Pedestrian Bridge	08/20/16
	Project Number	Designed
	2262.03	ENH
	Description	Checked
	1.75'x2.5' Canopy Column Design (Top of Col)	

Moment Magnification Factor per AASHTO LRFD 4.5.3.2.2b:

δ	1.03	1.02

Canopy LL				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	210	-4.7	0.0	1.5

Canopy LL		
Fz (k)	Mx (k-ft)	My (k-ft)
4.7	0.0	1.5

DC (Total)				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	210	-50.6	0.4	13.3

DC (Total)		
Fz (k)	Mx (k-ft)	My (k-ft)
50.6	0.4	13.6

WS_0 DEG				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	210	0.0	14.9	-0.1

WS_0 DEG		
Fz (k)	Mx (k-ft)	My (k-ft)
0.0	15.3	-0.1

WS_0 DEG_SRVI				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	210	0.0	11.9	-0.5

WS_0 DEG_SRVI		
Fz (k)	Mx (k-ft)	My (k-ft)
0.0	12.3	-0.5

WS_0 DEG_STRV				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	210	0.0	11.6	-0.5

WS_0 DEG_STRV		
Fz (k)	Mx (k-ft)	My (k-ft)
0.0	11.9	-0.5

WS_0 DEG_WEST				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	210	0.0	-7.5	0.1

WS_0 DEG_WEST		
Fz (k)	Mx (k-ft)	My (k-ft)
0.0	-7.7	0.1

WS_0 DEG_WEST_SRVI				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	210	0.0	-6.9	-0.3

WS_0 DEG_WEST_SRVI		
Fz (k)	Mx (k-ft)	My (k-ft)
0.0	-7.1	-0.3

WS_0 DEG_WEST_STRV				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	210	0.0	-6.7	-0.3

WS_0 DEG_WEST_STRV		
Fz (k)	Mx (k-ft)	My (k-ft)
0.0	-6.9	-0.3

WS_0 DEG_WEST+WUP				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	210	10.6	-7.7	6.9

WS_0 DEG_WEST+WUP		
Fz (k)	Mx (k-ft)	My (k-ft)
-10.6	-7.9	7.0

	Project	Date
FIGG	FIU Pedestrian Bridge	08/20/16
	Project Number	Designed
	2262.03	ENH
	Description	Checked
	1.75'x2.5' Canopy Column Design (Top of Col)	

Moment Magnification Factor per AASHTO LRFD 4.5.3.2.2b:

δ		1.03	1.02

WS_0 DEG+WUP				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	210	10.6	15.0	6.9

WS_0 DEG+WUP		
Fz (k)	Mx (k-ft)	My (k-ft)
-10.6	15.5	7.0

WS_90 DEG				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	210	-0.5	-0.2	-14.5

WS_90 DEG		
Fz (k)	Mx (k-ft)	My (k-ft)
0.5	-0.2	-14.8

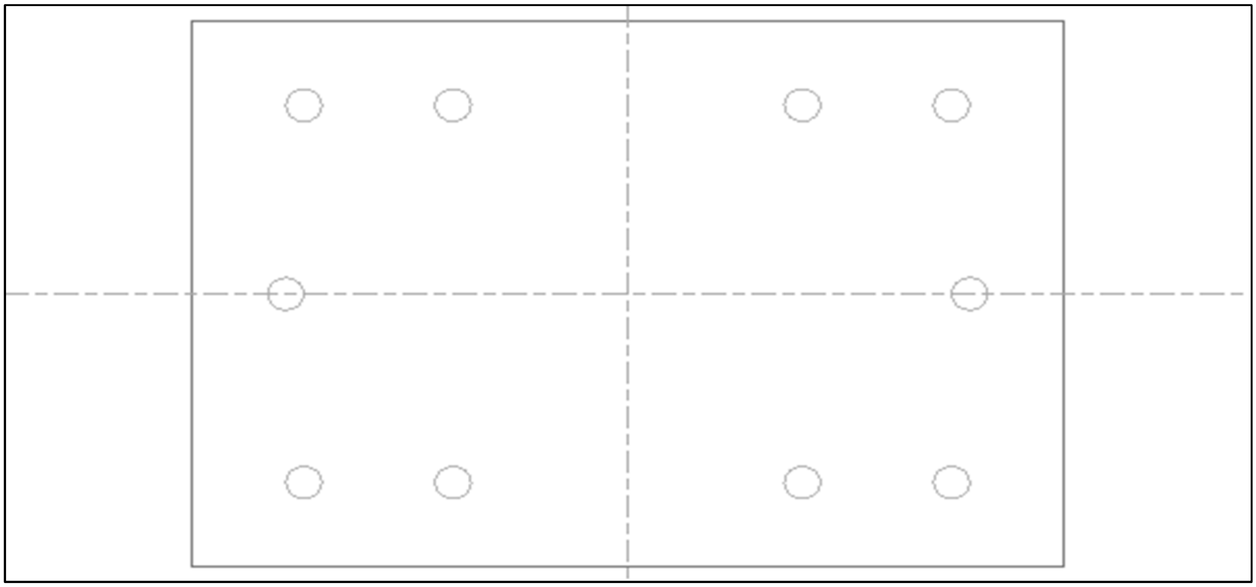
WS_90 DEG_SRVI				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	210	-0.4	-0.3	-13.0

WS_90 DEG_SRVI		
Fz (k)	Mx (k-ft)	My (k-ft)
0.4	-0.3	-13.3

WS_90 DEG_STRV				
Member	Joint	Fz (k)	Mx (k-ft)	My (k-ft)
212	210	-0.3	-0.3	-12.7

WS_90 DEG_STRV		
Fz (k)	Mx (k-ft)	My (k-ft)
0.3	-0.3	-13.0

Section ID: Cross Section 2



Material Properties

f'c (ksi)=	5.5	Strain @ Ult.=	0.003
f''c (ksi)=	4.96	Strain @ Max.=	0.0024
fy (ksi)=	60	E Conc. (ksi)=	3846
fr (ksi)=	0.563	E Rebar (ksi)=	29000
Tendon fpu (ksi)=	270	E Tendon (ksi)=	28500
PT Bar fpu (ksi)=	150	E PT Bar (ksi)=	30000
Gamma =	0.15		

Section Properties

Ix (in^4)=	23150	Iy (in^4)=	47245
Y top (in)=	10.4997	X lft (in)=	14.9996
Y bot (in)=	10.4997	X rgt (in)=	14.9996
Area (in^2)=	629.97	Ixy (in^4)=	0

Cross Section Coordinates

** Exterior Boundary Coordinates **

Point No.	X (in)	Y (in)	Point No.	X (in)	Y (in)
1	-15	10.5	2	15	10.5
3	15	-10.5	4	-15	-10.5

Rebar Information

Bar No.	X (in)	Y (in)	Dia. (in)	Area (in^2)
1	-11.75	0	1.25	1.23
2	11.12	7.25	1.25	1.23
3	-6	7.25	1.25	1.23
4	-11.12	7.25	1.25	1.23
5	-6	-7.25	1.25	1.23
6	-11.12	-7.25	1.25	1.23
7	11.12	-7.25	1.25	1.23
8	11.75	0	1.25	1.23
9	6	7.25	1.25	1.23
10	6	-7.25	1.25	1.23

Service Limit State Strain Criteria

Steel Tensile Strain Limit = 0.000828

Concrete Compressive Strain Limit = 0.003

1.75'x2.5' Canopy Support Column - South Plaza - Top of Column - Service III								
Section, Member & Joint	**SRV 3 Results**	**Combo ID**	**P (kips)**	**Mx (ft*kip)**	**My (ft*kip)**	**M (ft*kip)**	**Mn (ft*kip)**	**Mn/M**
	Max P	SRV 3/ 1	54.4	0.4	14.8	14.8	279.2	18.861
Section ID	Max Mx	SRV 3/ 1	54.4	0.4	14.8	14.8	279.2	18.861
Cross Section 2	Max My	SRV 3/ 1	54.4	0.4	14.8	14.8	279.2	18.861
Member	Max M	SRV 3/ 1	54.4	0.4	14.8	14.8	279.2	18.861
212	Min P	SRV 3/ 1	54.4	0.4	14.8	14.8	279.2	18.861
Joint	Min Mx	SRV 3/ 1	54.4	0.4	14.8	14.8	279.2	18.861
211	Min My	SRV 3/ 1	54.4	0.4	14.8	14.8	279.2	18.861
	Min M	SRV 3/ 1	54.4	0.4	14.8	14.8	279.2	18.861

MIN C/D =	**18.861**
CHECK	**OK**

1.75'x2.5' Canopy Support Column - South Plaza - Top of Column - Strength I								
Section, Member & Joint	**STR 1 Results**	**Combo ID**	**Pu (kips)**	**Mux (ft*kip)**	**Muy (ft*kip)**	**Mu (ft*kip)**	**ϕMn (ft*kip)**	**ϕMn/Mu**
	Max P	STR 1/ 1	71.5	0.5	19.6	19.6	719.6	36.655
Section ID	Max Mx	STR 1/ 1	71.5	0.5	19.6	19.6	719.6	36.655
Cross Section 2	Max My	STR 1/ 1	71.5	0.5	19.6	19.6	719.6	36.655
Member	Max M	STR 1/ 1	71.5	0.5	19.6	19.6	719.6	36.655
212	Min P	STR 1/ 2	53.8	0.4	14.9	14.9	705.6	47.451
Joint	Min Mx	STR 1/ 2	53.8	0.4	14.9	14.9	705.6	47.451
211	Min My	STR 1/ 2	53.8	0.4	14.9	14.9	705.6	47.451
	Min M	STR 1/ 2	53.8	0.4	14.9	14.9	705.6	47.451

MIN C/D =	**36.655**
CHECK	**OK**

1.75'x2.5' Canopy Support Column - South Plaza - Top of Column - Strength III								
Section, Member & Joint	**STR 3 Results**	**Combo ID**	**Pu (kips)**	**Mux (ft*kip)**	**Muy (ft*kip)**	**Mu (ft*kip)**	**ϕMn (ft*kip)**	**ϕMn/Mu**
	Max P	STR 3/ 5	64.0	0.2	-3.7	3.7	709.5	190.381
Section ID	Max Mx	STR 3/ 4	48.4	22.2	26.8	34.8	575.4	16.535
Cross Section 2	Max My	STR 3/ 3	48.4	-10.6	26.8	28.8	654.4	22.720
Member	Max M	STR 3/ 4	48.4	22.2	26.8	34.8	575.4	16.535
212	Min P	STR 3/ 8	30.7	-10.7	22.0	24.5	629.6	25.698
Joint	Min Mx	STR 3/ 8	30.7	-10.7	22.0	24.5	629.6	25.698
211	Min My	STR 3/ 10	46.2	0.1	-8.5	8.5	700.8	82.642
	Min M	STR 3/ 5	64.0	0.2	-3.7	3.7	709.5	190.381

MIN C/D =	**16.535**
CHECK	**OK**

1.75'x2.5' Canopy Support Column - South Plaza - Top of Column - Strength V								
Section, Member & Joint	**STR 5 Results**	**Combo ID**	**Pu (kips)**	**Mux (ft*kip)**	**Muy (ft*kip)**	**Mu (ft*kip)**	**ϕMn (ft*kip)**	**ϕMn/Mu**
	Max P	STR 5/ 3	69.7	0.4	13.8	13.8	718.1	51.921
Section ID	Max Mx	STR 5/ 1	69.6	5.3	18.8	19.5	688.4	35.220
Cross Section 2	Max My	STR 5/ 2	69.6	-2.3	18.9	19.0	705.4	37.050
Member	Max M	STR 5/ 1	69.6	5.3	18.8	19.5	688.4	35.220
212	Min P	STR 5/ 4	51.9	5.1	14.1	15.0	663.0	44.298
Joint	Min Mx	STR 5/ 5	51.9	-2.4	14.1	14.3	685.1	47.754
211	Min My	STR 5/ 6	52.0	0.2	9.1	9.1	704.1	77.640
	Min M	STR 5/ 6	52.0	0.2	9.1	9.1	704.1	77.640

MIN C/D =	**35.220**
CHECK	**OK**

FIGG	Project FIU Pedestrian Bridge	Date 09/30/16
	Project Number 2262.03	Designed ENH
	Description 14"x14" Canopy Support Post Design	Checked

Min. column reinf. per ACI 318-11 10.9.1: 4-#10

A_g (in^2)	196	
$A_{s,min}$ (in^2)	1.96	
$A_{s,prov}$ (in^2)	**5.08**	OK

Lap Splice Length per AASHTO LRFD 5.11.5.3.1: 69 in

% Spliced	100%
Class	C
A_b (in^2)	1.27
d_b (in)	1.27
l_{db} (in)	40.61
$1.7l_d$ (in)	69

FIGG	Project: FIU PEDESTRIAN BRIDGE	Date: 8/20/16	Page / Of
	Project Number: 2262.03	Designed: ENH	
	Description: 14" × 14" COLUMN DESIGN	Checked:	

TRANSVERSE DESIGN

From Strength load combinations : Max F_y = 8 Kips
Max F_z = 2 Kips

Fy Shear :

$d_v = 0.72h = 0.72(14 \text{ in}) = 10.1 \text{ in}$

Provide minimum reinforcement per AASHTO LRFD Section 5.8.2.5 :

$\frac{A_{v,min}}{S} = \frac{0.0316\sqrt{f'_c}\, b_v}{f_y} = \frac{0.0316\sqrt{5.5}\,(14 \text{ in})(12 \text{ in/ft})}{60 \text{ ksi}} = 0.21 \text{ in}^2/\text{ft}$

Try #4 @ 12" :

$\frac{A_v}{S} = \frac{2 \text{ legs } (0.20 \text{ in}^2)}{1 \text{ ft}} = 0.40 \frac{\text{in}^2}{\text{ft}} > 0.21 \frac{\text{in}^2}{\text{ft}}$ OK

Use $\beta = 2.0$ and $\theta = 45°$ for nonprestressed sections not subjected to axial tension per AASHTO LRFD Section 5.8.3.4.1.

$V_c = 0.0316\, \beta \sqrt{f'_c}\, b_v d_v = 0.0316(2)\sqrt{5.5}\,(14 \text{ in})(10.1 \text{ in}) = 21 \text{ Kips}$

$0.5\, \phi V_c = 0.5(0.9)(21 \text{ Kips}) = 9 \text{ Kips} > V_u \rightarrow$ Min. reinforcement only per Eq. 5.8.2.4-1.

Fz Shear :

Column is doubly symmetric. By inspection, Fy shear governs design.

Moment Magnification Factor (My & Mz)

Input

$l_u := 15.15\text{ft}$ $E_c := 3846\text{ksi}$ $P_{DC} := 30.6\text{kip}$ $M_{DC} := 49.1\text{kip}\cdot\text{ft}$

$k := 1.0$ $I_g := 0.15\text{ft}^4$ $P_{WS} := 2.9\text{kip}$ $M_{WS} := 8.8\text{kip}\cdot\text{ft}$

$h := 14\text{in}$ $C_m := 1.0$

$\phi_K := 0.75$

Check Slenderness (AASHTO LRFD 5.7.4.3)

$$\lambda := \frac{(k \cdot l_u)}{0.3 \cdot h} = 43.29$$

Check1 := if(λ > 22, "Consider Slenderness", "Neglect Slenderness")

Check1 = "Consider Slenderness"

Determine EI (AASHTO LRFD 5.7.4.3)

$$M_{TOT} := 1.25M_{DC} + 1.40M_{WS} = 74 \cdot \text{ft} \cdot \text{kip}$$

$$M_{PERM} := 1.25M_{DC} = 61 \cdot \text{ft} \cdot \text{kip}$$

$$\beta_d := \frac{|M_{PERM}|}{|M_{TOT}|} = 0.833$$

$$EI := \frac{0.4E_c \cdot I_g}{1 + \beta_d} = 2.611 \times 10^6 \cdot \text{kip} \cdot \text{in}^2$$

Determine Euler Buckling Load (AASHTO LRFD 4.5.3.2.2b)

$$P_e := \frac{\pi^2 \cdot EI}{(k \cdot l_u)^2} = 780 \cdot \text{kip}$$

Determine Moment Magnification Factors (AASHTO LRFD 4.5.3.2.2b)

$$P_u := 1.25P_{DC} + 1.40P_{WS} = 42 \cdot \text{kip}$$

$$\delta_b := \frac{C_m}{1 - \frac{P_u}{\phi_K \cdot P_e}} = 1.08$$

$$\delta_s := \delta_b = 1.08$$

	Project	Date
FIGG	FIU Pedestrian Bridge	08/20/16
	Project Number	Designed
	2262.03	ENH
	Description	Checked
	14"x14" Canopy Post Design (Bot. of Column)	

Moment Magnification Factor per AASHTO LRFD 4.5.3.2.2b:

δ	1.08	1.08

Canopy LL					Canopy LL		
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)	Fx (k)	My (k-ft)	Mz (k-ft)
207	208	-2.7	0.5	2.4	2.7	0.5	2.6
208	209	-2.7	0.6	-2.4	2.7	0.6	-2.6

DC (Total)					DC (Total)		
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)	Fx (k)	My (k-ft)	Mz (k-ft)
207	208	-30.6	-5.7	49.1	30.6	-6.2	53.0
208	209	-30.5	-5.4	-49.2	30.5	-5.8	-53.1

WS_0 DEG					WS_0 DEG		
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)	Fx (k)	My (k-ft)	Mz (k-ft)
207	208	-2.9	-1.4	8.8	2.9	-1.5	9.5
208	209	2.9	1.1	9.7	-2.9	1.2	10.5

WS_0 DEG_SRVI					WS_0 DEG_SRVI		
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)	Fx (k)	My (k-ft)	Mz (k-ft)
207	208	-2.2	-1.4	6.5	2.2	-1.5	7.0
208	209	2.2	0.6	6.1	-2.2	0.6	6.6

WS_0 DEG_STRV					WS_0 DEG_STRV		
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)	Fx (k)	My (k-ft)	Mz (k-ft)
207	208	-2.1	-1.3	6.3	2.1	-1.4	6.8
208	209	2.2	0.6	6.0	-2.2	0.6	6.5

WS_0 DEG_WEST					WS_0 DEG_WEST		
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)	Fx (k)	My (k-ft)	Mz (k-ft)
207	208	1.9	1.3	-8.3	-1.9	1.4	-9.0
208	209	-1.9	-1.5	-6.9	1.9	-1.6	-7.5

WS_0 DEG_WEST_SRVI					WS_0 DEG_WEST_SRVI		
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)	Fx (k)	My (k-ft)	Mz (k-ft)
207	208	1.6	0.9	-5.7	-1.6	1.0	-6.2
208	209	-1.6	-1.5	-5.5	1.6	-1.6	-5.9

	Project	Date
FIGG	FIU Pedestrian Bridge	08/20/16
	Project Number	Designed
	2262.03	ENH
	Description	Checked
	14"x14" Canopy Post Design (Bot. of Column)	

Moment Magnification Factor per AASHTO LRFD 4.5.3.2.2b:

δ	1.08	1.08

WS_0 DEG_WEST_STRV				
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)
207	208	1.6	0.8	-5.5
208	209	-1.6	-1.4	-5.4

WS_0 DEG_WEST_STRV		
Fx (k)	My (k-ft)	Mz (k-ft)
-1.6	0.9	-5.9
1.6	-1.5	-5.8

WS_0 DEG_WEST+WUP				
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)
207	208	7.6	-1.2	-13.5
208	209	3.7	-3.9	-1.8

WS_0 DEG_WEST+WUP		
Fx (k)	My (k-ft)	Mz (k-ft)
-7.6	-1.3	-14.6
-3.7	-4.2	-1.9

WS_0 DEG+WUP				
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)
207	208	2.7	-3.5	3.6
208	209	8.6	-1.2	14.9

WS_0 DEG+WUP		
Fx (k)	My (k-ft)	Mz (k-ft)
-2.7	-3.8	3.9
-8.6	-1.3	16.1

WS_90 DEG				
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)
207	208	0.2	-0.2	-1.1
208	209	0.2	-0.4	1.2

WS_90 DEG		
Fx (k)	My (k-ft)	Mz (k-ft)
-0.2	-0.2	-1.2
-0.2	-0.4	1.3

WS_90 DEG_SRVI				
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)
207	208	0.3	3.3	-2.6
208	209	0.3	3.1	2.8

WS_90 DEG_SRVI		
Fx (k)	My (k-ft)	Mz (k-ft)
-0.3	3.6	-2.8
-0.3	3.3	3.0

WS_90 DEG_STRV				
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)
207	208	0.3	3.2	-2.6
208	209	0.3	3.0	2.7

WS_90 DEG_STRV		
Fx (k)	My (k-ft)	Mz (k-ft)
-0.3	3.5	-2.8
-0.3	3.2	2.9

XTRACT Section Report

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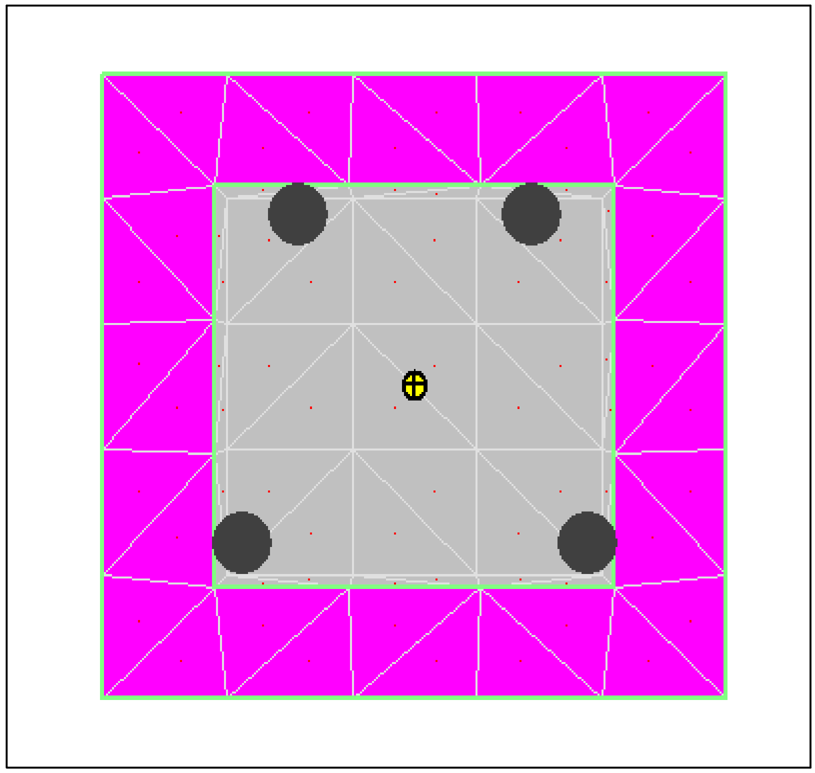
Section Name: Bent Column

Section Details:

X Centroid:	-11.12E-6 ft
Y Centroid:	2.157E-3 ft
Section Area:	1.361 ft^2
EI gross about X:	103.6E+3 kip-ft^2
EI gross about Y:	101.2E+3 kip-ft^2
I trans (Unconfined1) about X:	.1702 ft^4
I trans (Unconfined1) about Y:	.1663 ft^4
Reinforcing Bar Area:	35.19E-3 ft^2
Percent Longitudinal Steel:	2.586 %
Overall Width:	1.167 ft
Overall Height:	1.167 ft
Number of Fibers:	74
Number of Bars:	4
Number of Materials:	3



Material Types and Names:

Unconfined Concrete:	Unconfined1
Confined Concrete:	Confined1
Strain Hardening Steel:	Steel1

Comments:

User Comments

Service III check performed using XTRACT.

XTRACT Material Report

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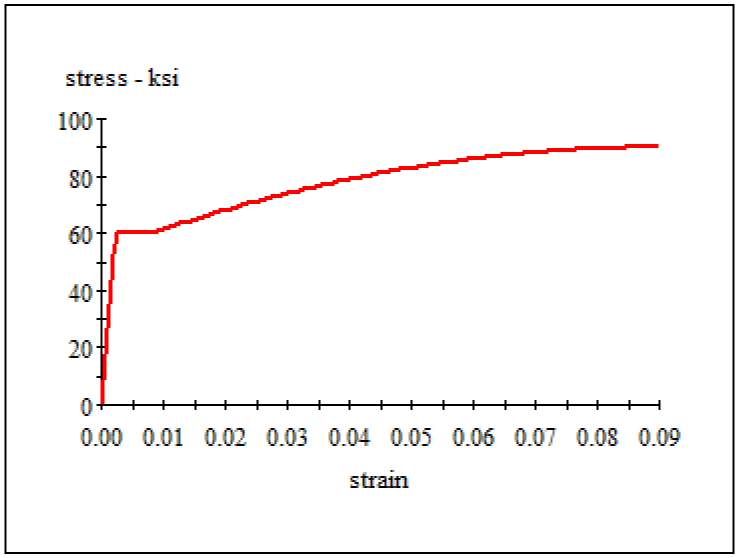
Material Name: Steel1

Material Type: Strain Hardening Steel

Input Parameters:

Yield Stress:	60.00 ksi
Fracture Stress:	90.00 ksi
Yield Strain:	2.069E-3
Strain at Strain Hardening:	8.000E-3
Failure Strain:	90.00E-3
Elastic Modulus:	29.00E+3 ksi
Additional Information:	Symetric Tension and Comp.



Model Details:

For Strain - $\varepsilon < \varepsilon_y$ $\quad fs = E \cdot \varepsilon$

For Strain - $\varepsilon < \varepsilon_{sh}$ $\quad fs = f_y$

For Strain - $\varepsilon < \varepsilon_{su}$ $\quad fs = f_u - (f_u - f_y) \cdot \left(\frac{\varepsilon_{su} - \varepsilon}{\varepsilon_{su} - \varepsilon_{sh}} \right)^2$

ε = Steel Strain

fs = Steel Stress

f_y = Yield Stress

f_u = Fracture Stress

ε_y = Yield Strain

ε_{sh} = Strain at Strain Hardening

ε_{su} = Failure Strain

E = Elastic Modulus

Material Color States:

- Tension force after onset of strain hardening
- Tension force after yield
- Initial state
- Compression force after yield
- Compression force after onset of strain hardening

XTRACT Analysis Report

Section Name: Bent Column
Loading Name: service III
Analysis Type: Moment Curvature

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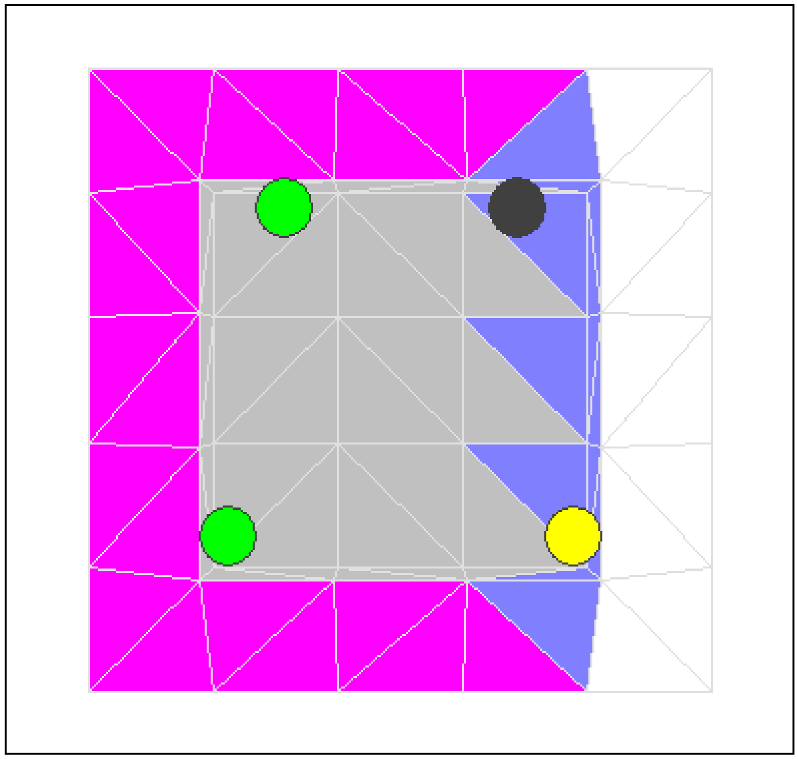
Section Details:

X Centroid: -11.12E-6 ft
Y Centroid: 2.157E-3 ft
Section Area: 1.361 ft^2

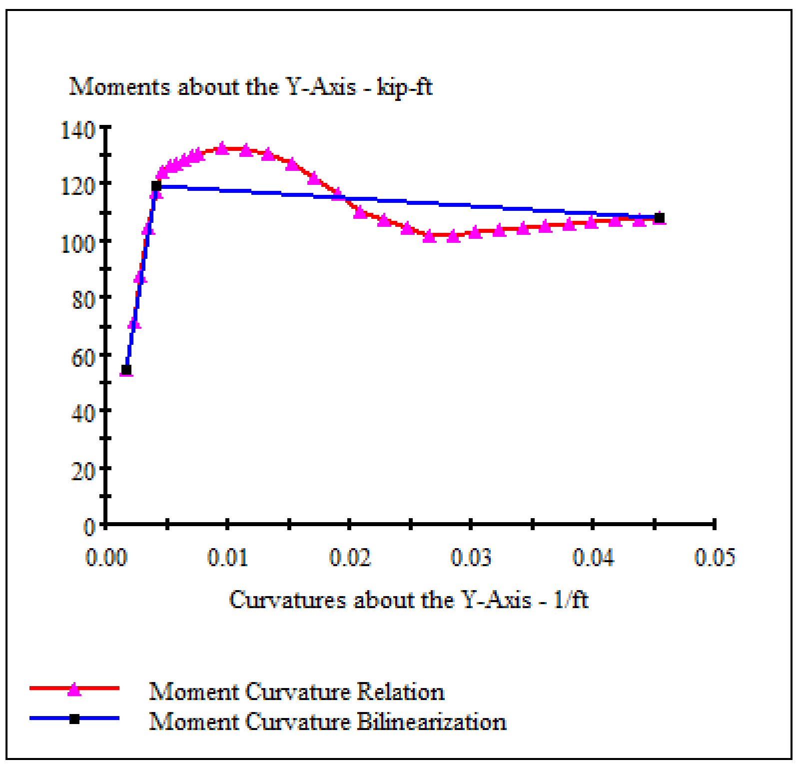


Loading Details:

Constant Load - P: 32.80 kips
Constant Load - Mxx: -5.800 kip-ft
Constant Load - Myy: -55.20 kip-ft
Incrementing Loads: Myy Only
Number of Points: 30
Analysis Strategy: Displacement Control

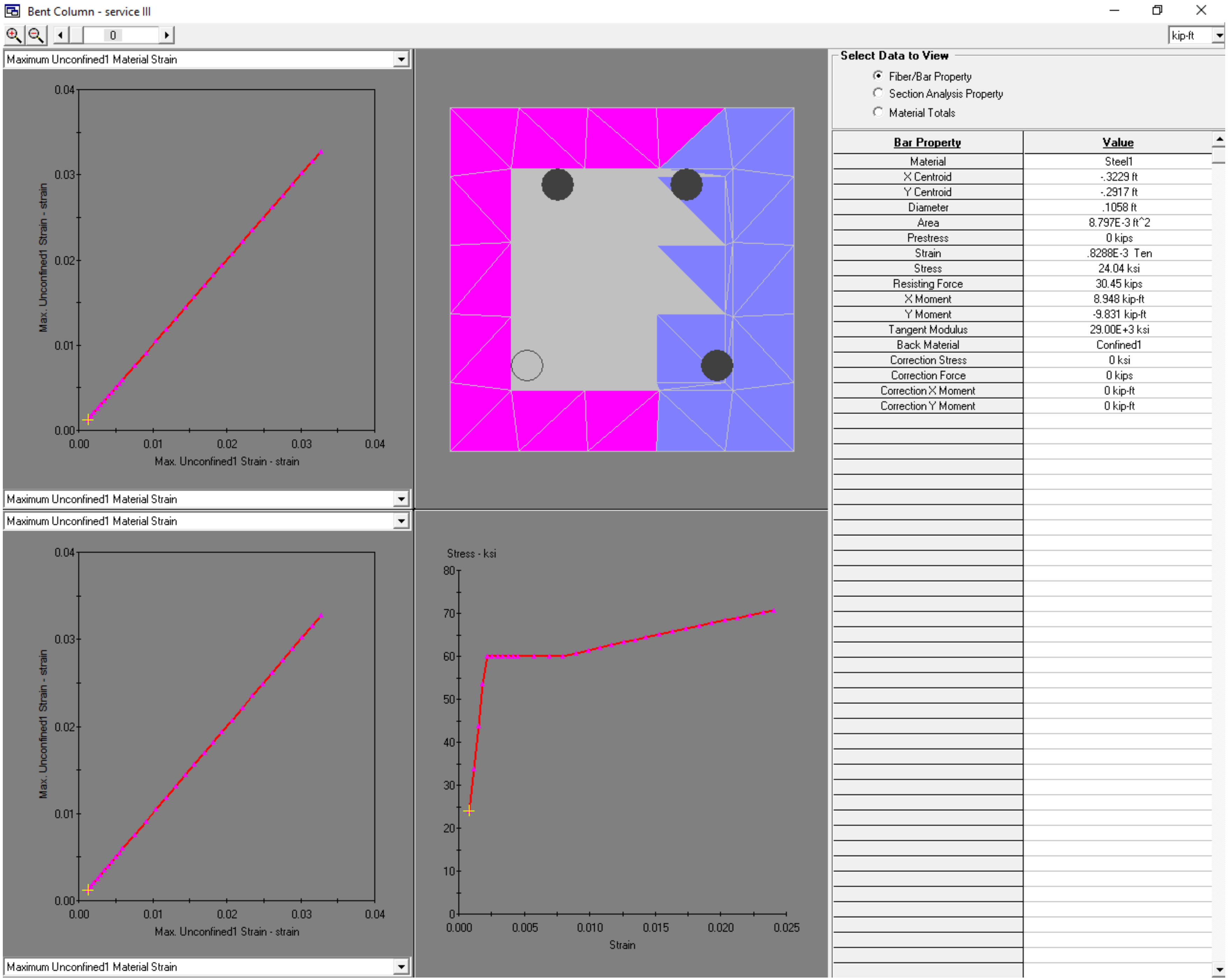
Analysis Results:

Failing Material: Confined1
Failure Strain: 7.273E-3 Compression
Curvature at Initial Load: 1.653E-3 1/ft
Curvature at First Yield: 3.826E-3 1/ft
Ultimate Curvature: 45.45E-3 1/ft
Moment at First Yield: 113.3 kip-ft
Ultimate Moment: 108.5 kip-ft
Centroid Strain at Yield: .8567E-3 Ten
Centroid Strain at Ultimate: 9.391E-3 Ten
N.A. at First Yield: .2239 ft
N.A. at Ultimate: .2066 ft
Energy per Length: 4.931 kips
Effective Yield Curvature: 4.063E-3 1/ft
Effective Yield Moment: 119.6 kip-ft
Over Strength Factor: .9071
EI Effective: 26.72E+3 kip-ft^2
Yield EI Effective: -268.6 kip-ft^2
Bilinear Harding Slope: -1.005 %
Curvature Ductility: 11.19



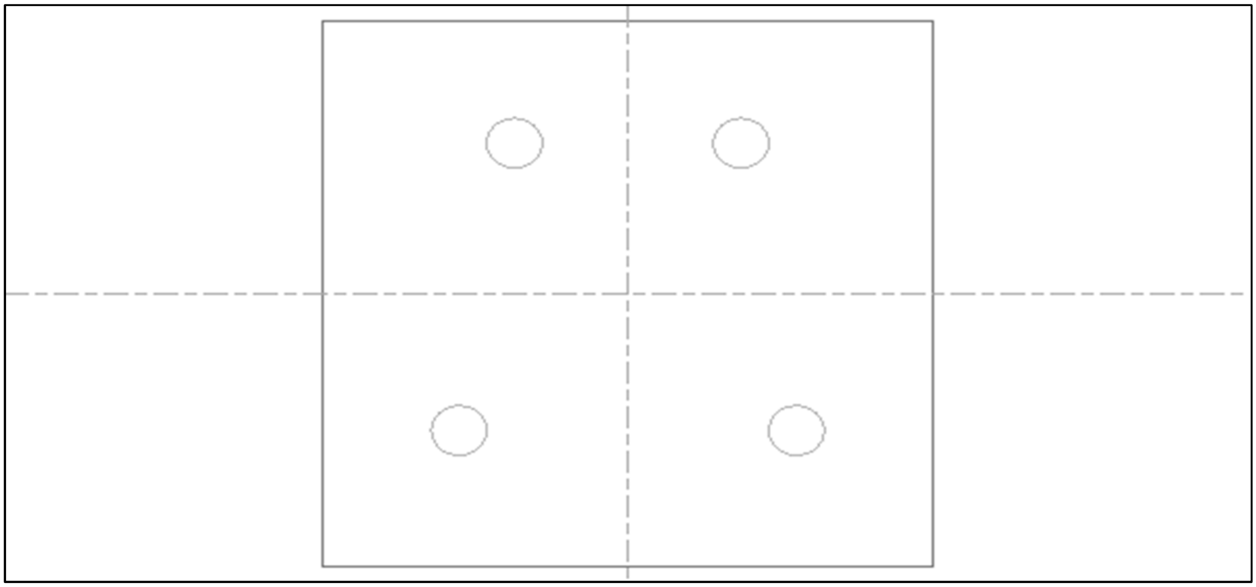
Comments:

User Comments



Bent Column - service III
kip-ft
Maximum Unconfined1 Material Strain
Max. Unconfined1 Strain - strain
Max. Unconfined1 Strain - strain
Maximum Unconfined1 Material Strain
Maximum Unconfined1 Material Strain
Max. Unconfined1 Strain - strain
Max. Unconfined1 Strain - strain
Maximum Unconfined1 Material Strain
Stress - ksi
Strain
Select Data to View
Fiber/Bar Property
Section Analysis Property
Material Totals
Bar Property | Value
Material | Steel1
X Centroid | -.3229 ft
Y Centroid | -.2917 ft
Diameter | .1058 ft
Area | 8.797E-3 ft^2
Prestress | 0 kips
Strain | .8288E-3 Ten
Stress | 24.04 ksi
Resisting Force | 30.45 kips
X Moment | 8.948 kip-ft
Y Moment | -9.831 kip-ft
Tangent Modulus | 29.00E+3 ksi
Back Material | Confined1
Correction Stress | 0 ksi
Correction Force | 0 kips
Correction X Moment | 0 kip-ft
Correction Y Moment | 0 kip-ft

Section ID: Cross Section 1



Material Properties

f'c (ksi)=	5.5	Strain @ Ult.=	0.003
f''c (ksi)=	4.96	Strain @ Max.=	0.0024
fy (ksi)=	60	E Conc. (ksi)=	3846
fr (ksi)=	0.563	E Rebar (ksi)=	29000
Tendon fpu (ksi)=	270	E Tendon (ksi)=	28500
PT Bar fpu (ksi)=	150	E PT Bar (ksi)=	30000
Gamma =	0.15		

Section Properties

Ix (in^4)=	3201	Iy (in^4)=	3201
Y top (in)=	7	X lft (in)=	7
Y bot (in)=	7	X rgt (in)=	7
Area (in^2)=	196	Ixy (in^4)=	0

Cross Section Coordinates

** Exterior Boundary Coordinates **

Point No.	X (in)	Y (in)	Point No.	X (in)	Y (in)
1	-7	7	2	7	7
3	7	-7	4	-7	-7

Rebar Information

Bar No.	X (in)	Y (in)	Dia. (in)	Area (in^2)
1	-3.86	-3.5	1.27	1.27
2	-2.59	3.86	1.27	1.27
3	3.86	-3.5	1.27	1.27
4	2.59	3.86	1.27	1.27

14"x14" Canopy Support Post - South Plaza - Bottom of Column - Strength I								
Section, Member & Joint	**STR 1 Results**	**Combo ID**	**Pu (kips)**	**Mux (ft*kip)**	**Muy (ft*kip)**	**Mu (ft*kip)**	**ϕMn (ft*kip)**	**ϕMn/Mu**
	Max P	STR 1/ 1	43.0	-6.9	70.8	71.1	119.8	1.684
Section ID	Max Mx	STR 1/ 2	32.3	-4.7	52.3	52.5	116.5	2.221
Cross Section 1	Max My	STR 1/ 1	43.0	-6.9	70.8	71.1	119.8	1.684
Member	Max M	STR 1/ 1	43.0	-6.9	70.8	71.1	119.8	1.684
207	Min P	STR 1/ 2	32.3	-4.7	52.3	52.5	116.5	2.221
Joint	Min Mx	STR 1/ 1	43.0	-6.9	70.8	71.1	119.8	1.684
208	Min My	STR 1/ 2	32.3	-4.7	52.3	52.5	116.5	2.221
	Min M	STR 1/ 2	32.3	-4.7	52.3	52.5	116.5	2.221
	Max P	STR 1/ 1	42.9	-6.2	-70.9	71.2	120.7	1.696
Section ID	Max Mx	STR 1/ 2	32.2	-4.2	-52.3	52.5	115.5	2.200
Cross Section 1	Max My	STR 1/ 2	32.2	-4.2	-52.3	52.5	115.5	2.200
Member	Max M	STR 1/ 1	42.9	-6.2	-70.9	71.2	120.7	1.696
208	Min P	STR 1/ 2	32.2	-4.2	-52.3	52.5	115.5	2.200
Joint	Min Mx	STR 1/ 1	42.9	-6.2	-70.9	71.2	120.7	1.696
209	Min My	STR 1/ 1	42.9	-6.2	-70.9	71.2	120.7	1.696
	Min M	STR 1/ 2	32.2	-4.2	-52.3	52.5	115.5	2.200

MIN C/D =	**1.684**
CHECK	**OK**

14"x14" Canopy Support Post - South Plaza - Bottom of Column - Strength III								
Section, Member & Joint	**STR 3 Results**	**Combo ID**	**Pu (kips)**	**Mux (ft*kip)**	**Muy (ft*kip)**	**Mu (ft*kip)**	**ϕMn (ft*kip)**	**ϕMn/Mu**
	Max P	STR 3/ 1	42.3	-9.9	79.6	80.2	120.1	1.499
Section ID	Max Mx	STR 3/ 7	24.9	-3.6	35.1	35.3	114.6	3.248
Cross Section 1	Max My	STR 3/ 1	42.3	-9.9	79.6	80.2	120.1	1.499
Member	Max M	STR 3/ 1	42.3	-9.9	79.6	80.2	120.1	1.499
207	Min P	STR 3/ 10	16.9	-7.4	27.3	28.2	107.4	3.801
Joint	Min Mx	STR 3/ 4	34.5	-13.1	71.7	72.9	114.7	1.573
208	Min My	STR 3/ 10	16.9	-7.4	27.3	28.2	107.4	3.801
	Min M	STR 3/ 10	16.9	-7.4	27.3	28.2	107.4	3.801
	Max P	STR 3/ 2	40.8	-9.5	-76.9	77.5	119.7	1.545
Section ID	Max Mx	STR 3/ 6	23.4	-3.5	-33.1	33.3	114.3	3.435
Cross Section 1	Max My	STR 3/ 9	15.4	-7.0	-25.3	26.2	106.8	4.073
Member	Max M	STR 3/ 2	40.8	-9.5	-76.9	77.5	119.7	1.545
208	Min P	STR 3/ 9	15.4	-7.0	-25.3	26.2	106.8	4.073
Joint	Min Mx	STR 3/ 5	32.9	-13.1	-69.0	70.3	114.0	1.622
209	Min My	STR 3/ 2	40.8	-9.5	-76.9	77.5	119.7	1.545
	Min M	STR 3/ 9	15.4	-7.0	-25.3	26.2	106.8	4.073

MIN C/D =	**1.499**
CHECK	**OK**

14"x14" Canopy Support Post - South Plaza - Bottom of Column - Strength V								
Section, Member & Joint	**STR 5 Results**	**Combo ID**	**Pu (kips)**	**Mux (ft*kip)**	**Muy (ft*kip)**	**Mu (ft*kip)**	**ϕMn (ft*kip)**	**ϕMn/Mu**
	Max P	STR 5/ 1	42.7	-7.6	72.5	72.9	119.9	1.645
Section ID	Max Mx	STR 5/ 6	31.1	-3.5	50.1	50.2	115.8	2.305
Cross Section 1	Max My	STR 5/ 1	42.7	-7.6	72.5	72.9	119.9	1.645
Member	Max M	STR 5/ 1	42.7	-7.6	72.5	72.9	119.9	1.645
207	Min P	STR 5/ 5	30.5	-4.5	48.9	49.1	116.1	2.366
Joint	Min Mx	STR 5/ 1	42.7	-7.6	72.5	72.9	119.9	1.645
208	Min My	STR 5/ 5	30.5	-4.5	48.9	49.1	116.1	2.366
	Min M	STR 5/ 5	30.5	-4.5	48.9	49.1	116.1	2.366
	Max P	STR 5/ 2	42.4	-7.0	-72.2	72.5	119.6	1.649
Section ID	Max Mx	STR 5/ 6	31.0	-3.1	-50.1	50.2	115.6	2.301
Cross Section 1	Max My	STR 5/ 4	30.2	-4.2	-48.7	48.9	115.8	2.368
Member	Max M	STR 5/ 2	42.4	-7.0	-72.2	72.5	119.6	1.649
208	Min P	STR 5/ 4	30.2	-4.2	-48.7	48.9	115.8	2.368
Joint	Min Mx	STR 5/ 2	42.4	-7.0	-72.2	72.5	119.6	1.649
209	Min My	STR 5/ 2	42.4	-7.0	-72.2	72.5	119.6	1.649
	Min M	STR 5/ 4	30.2	-4.2	-48.7	48.9	115.8	2.368

MIN C/D =	**1.645**
CHECK	**OK**

Moment Magnification Factor (My & Mz)

Input

$l_u := 15.15ft$ $E_c := 3846ksi$ $P_{DC} := 27.8kip$ $M_{DC} := 26.9kip \cdot ft$

$k := 1.0$ $I_g := 0.15ft^4$ $P_{WS} := 2.9kip$ $M_{WS} := 8.5kip \cdot ft$

$h := 14in$ $C_m := 1.0$

$\phi_K := 0.75$

Check Slenderness (AASHTO LRFD 5.7.4.3)

$$\lambda := \frac{(k \cdot l_u)}{0.3 \cdot h} = 43.29$$

Check1 := if(λ > 22, "Consider Slenderness" , "Neglect Slenderness")

Check1 = "Consider Slenderness"

Determine EI (AASHTO LRFD 5.7.4.3)

$$M_{TOT} := 1.25M_{DC} + 1.40M_{WS} = 46 \cdot ft \cdot kip$$

$$M_{PERM} := 1.25M_{DC} = 34 \cdot ft \cdot kip$$

$$\beta_d := \frac{|M_{PERM}|}{|M_{TOT}|} = 0.739$$

$$EI := \frac{0.4E_c \cdot I_g}{1 + \beta_d} = 2.752 \times 10^6 \cdot kip \cdot in^2$$

Determine Euler Buckling Load (AASHTO LRFD 4.5.3.2.2b)

$$P_e := \frac{\pi^2 \cdot EI}{(k \cdot l_u)^2} = 822 \cdot kip$$

Determine Moment Magnification Factors (AASHTO LRFD 4.5.3.2.2b)

$$P_u := 1.25P_{DC} + 1.40P_{WS} = 39 \cdot kip$$

$$\delta_b := \frac{C_m}{1 - \frac{P_u}{\phi_K \cdot P_e}} = 1.07$$

$$\delta_s := \delta_b = 1.07$$

	Project	Date
FIGG	FIU Pedestrian Bridge	08/20/16
	Project Number	Designed
	2262.03	ENH
	Description	Checked
	14"x14" Canopy Post Design (Top of Column)	

Moment Magnification Factor per AASHTO LRFD 4.5.3.2.2b:

δ	1.07	1.07

Canopy LL							
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)	Fx (k)	My (k-ft)	Mz (k-ft)
207	206	2.7	2.1	1.3	2.7	2.2	1.4
208	207	2.7	2.1	-1.4	2.7	2.2	-1.5

DC (Total)							
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)	Fx (k)	My (k-ft)	Mz (k-ft)
207	206	27.8	10.0	26.9	27.8	10.7	28.8
208	207	27.7	10.2	-27.0	27.7	10.9	-28.9

WS_0 DEG							
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)	Fx (k)	My (k-ft)	Mz (k-ft)
207	206	2.9	-1.1	8.5	2.9	-1.2	9.1
208	207	-2.9	0.7	6.1	-2.9	0.7	6.5

WS_0 DEG_SRVI							
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)	Fx (k)	My (k-ft)	Mz (k-ft)
207	206	2.2	-1.1	6.2	2.2	-1.2	6.6
208	207	-2.2	0.3	4.1	-2.2	0.3	4.4

WS_0 DEG_STRV							
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)	Fx (k)	My (k-ft)	Mz (k-ft)
207	206	2.1	-1.0	6.1	2.1	-1.1	6.5
208	207	-2.2	0.3	4.0	-2.2	0.3	4.3

WS_0 DEG_WEST							
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)	Fx (k)	My (k-ft)	Mz (k-ft)
207	206	-1.9	1.1	-4.7	-1.9	1.2	-5.0
208	207	1.9	-1.3	-6.9	1.9	-1.4	-7.4

WS_0 DEG_WEST_SRVI							
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)	Fx (k)	My (k-ft)	Mz (k-ft)
207	206	-1.6	0.6	-3.6	-1.6	0.6	-3.9
208	207	1.6	-1.3	-5.4	1.6	-1.4	-5.8

Moment Magnification Factor per AASHTO LRFD 4.5.3.2.2b:

δ	1.07	1.07

WS_0 DEG_WEST_STRV				
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)
207	206	-1.6	0.6	-3.5
208	207	1.6	-1.3	-5.3

WS_0 DEG_WEST_STRV		
Fx (k)	My (k-ft)	Mz (k-ft)
-1.6	0.6	-3.7
1.6	-1.4	-5.7

WS_0 DEG_WEST+WUP				
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)
207	206	-7.6	-5.7	-7.5
208	207	-3.7	-8.1	-4.0

WS_0 DEG_WEST+WUP		
Fx (k)	My (k-ft)	Mz (k-ft)
-7.6	-6.1	-8.0
-3.7	-8.7	-4.3

WS_0 DEG+WUP				
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)
207	206	-2.7	-7.5	5.7
208	207	-8.6	-5.9	9.0

WS_0 DEG+WUP		
Fx (k)	My (k-ft)	Mz (k-ft)
-2.7	-8.0	6.1
-8.6	-6.3	9.6

WS_90 DEG				
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)
207	206	-0.4	-0.6	-0.6
208	207	-0.4	-0.8	0.8

WS_90 DEG		
Fx (k)	My (k-ft)	Mz (k-ft)
-0.4	-0.6	-0.6
-0.4	-0.9	0.9

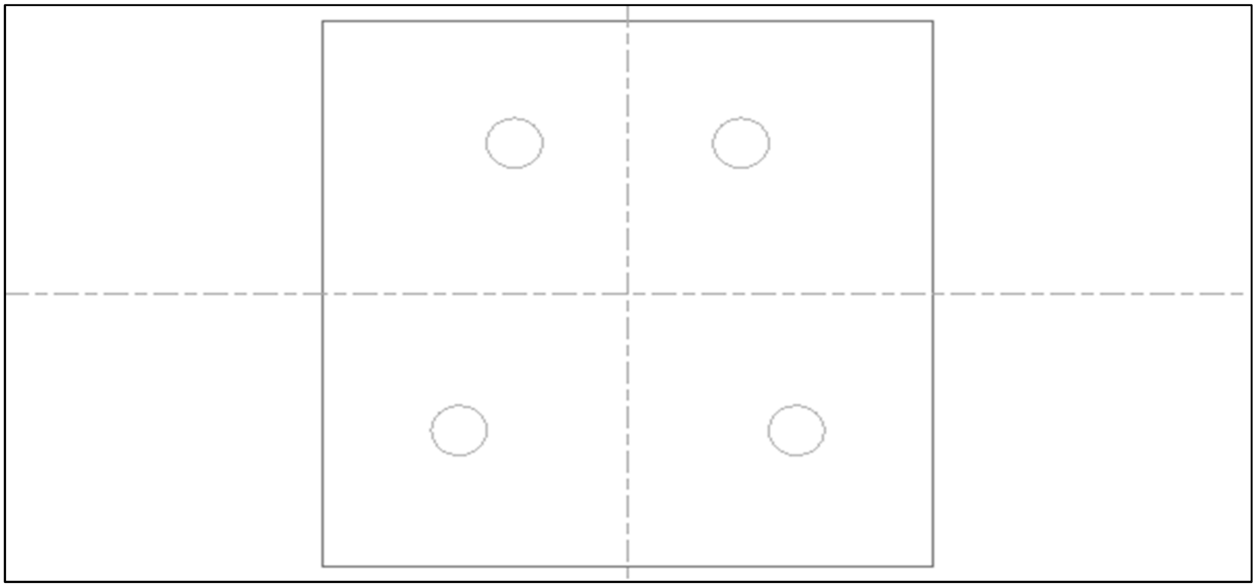
WS_90 DEG_SRVI				
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)
207	206	-0.4	1.3	-1.4
208	207	-0.4	0.9	1.7

WS_90 DEG_SRVI		
Fx (k)	My (k-ft)	Mz (k-ft)
-0.4	1.4	-1.5
-0.4	1.0	1.8

WS_90 DEG_STRV				
Member	Joint	Fx (k)	My (k-ft)	Mz (k-ft)
207	206	-0.4	1.2	-1.4
208	207	-0.4	0.9	1.6

WS_90 DEG_STRV		
Fx (k)	My (k-ft)	Mz (k-ft)
-0.4	1.3	-1.5
-0.4	1.0	1.7

Section ID: Cross Section 1



Material Properties

f'c (ksi)=	5.5	Strain @ Ult.=	0.003
f''c (ksi)=	4.96	Strain @ Max.=	0.0024
fy (ksi)=	60	E Conc. (ksi)=	3846
fr (ksi)=	0.563	E Rebar (ksi)=	29000
Tendon fpu (ksi)=	270	E Tendon (ksi)=	28500
PT Bar fpu (ksi)=	150	E PT Bar (ksi)=	30000
Gamma =	0.15		

Section Properties

Ix (in^4)=	3201	Iy (in^4)=	3201
Y top (in)=	7	X lft (in)=	7
Y bot (in)=	7	X rgt (in)=	7
Area (in^2)=	196	Ixy (in^4)=	0

Cross Section Coordinates

** Exterior Boundary Coordinates **

Point No.	X (in)	Y (in)	Point No.	X (in)	Y (in)
1	-7	7	2	7	7
3	7	-7	4	-7	-7

Rebar Information

Bar No.	X (in)	Y (in)	Dia. (in)	Area (in^2)
1	-3.86	-3.5	1.27	1.27
2	-2.59	3.86	1.27	1.27
3	3.86	-3.5	1.27	1.27
4	2.59	3.86	1.27	1.27

Service Limit State Strain Criteria

Steel Tensile Strain Limit = 0.000828
Concrete Compressive Strain Limit = 0.003

14"x14" Canopy Support Post - South Plaza - Top of Column - Service III

Section, Member & Joint	SRV 3 Results	Combo ID	P (kips)	Mx (ft*kip)	My (ft*kip)	M (ft*kip)	Mn (ft*kip)	Mn/M
	Max P	SRV 3/ 1	30.0	12.5	29.9	32.4	47.6	1.469
Section ID	Max Mx	SRV 3/ 1	30.0	12.5	29.9	32.4	47.6	1.469
Cross Section 1	Max My	SRV 3/ 1	30.0	12.5	29.9	32.4	47.6	1.469
Member	Max M	SRV 3/ 1	30.0	12.5	29.9	32.4	47.6	1.469
207	Min P	SRV 3/ 1	30.0	12.5	29.9	32.4	47.6	1.469
Joint	Min Mx	SRV 3/ 1	30.0	12.5	29.9	32.4	47.6	1.469
208	Min My	SRV 3/ 1	30.0	12.5	29.9	32.4	47.6	1.469
	Min M	SRV 3/ 1	30.0	12.5	29.9	32.4	47.6	1.469
	Max P	SRV 3/ 1	29.9	12.7	-30.1	32.7	47.6	1.457
Section ID	Max Mx	SRV 3/ 1	29.9	12.7	-30.1	32.7	47.6	1.457
Cross Section 1	Max My	SRV 3/ 1	29.9	12.7	-30.1	32.7	47.6	1.457
Member	Max M	SRV 3/ 1	29.9	12.7	-30.1	32.7	47.6	1.457
208	Min P	SRV 3/ 1	29.9	12.7	-30.1	32.7	47.6	1.457
Joint	Min Mx	SRV 3/ 1	29.9	12.7	-30.1	32.7	47.6	1.457
209	Min My	SRV 3/ 1	29.9	12.7	-30.1	32.7	47.6	1.457
	Min M	SRV 3/ 1	29.9	12.7	-30.1	32.7	47.6	1.457

MIN C/D =	**1.457**
CHECK	**OK**

14"x14" Canopy Support Post - South Plaza - Top of Column - Strength I								
Section, Member & Joint	**STR 1 Results**	**Combo ID**	**Pu (kips)**	**Mux (ft*kip)**	**Muy (ft*kip)**	**Mu (ft*kip)**	**ϕMn (ft*kip)**	**ϕMn/Mu**
	Max P	STR 1/ 1	39.5	17.2	38.5	42.1	97.8	2.322
Section ID	Max Mx	STR 1/ 1	39.5	17.2	38.5	42.1	97.8	2.322
Cross Section 1	Max My	STR 1/ 1	39.5	17.2	38.5	42.1	97.8	2.322
Member	Max M	STR 1/ 1	39.5	17.2	38.5	42.1	97.8	2.322
207	Min P	STR 1/ 2	29.7	13.5	28.4	31.4	95.8	3.050
Joint	Min Mx	STR 1/ 2	29.7	13.5	28.4	31.4	95.8	3.050
208	Min My	STR 1/ 2	29.7	13.5	28.4	31.4	95.8	3.050
	Min M	STR 1/ 2	29.7	13.5	28.4	31.4	95.8	3.050
	Max P	STR 1/ 1	39.4	17.5	-38.8	42.5	97.7	2.299
Section ID	Max Mx	STR 1/ 1	39.4	17.5	-38.8	42.5	97.7	2.299
Cross Section 1	Max My	STR 1/ 2	29.7	13.7	-28.6	31.7	95.8	3.018
Member	Max M	STR 1/ 1	39.4	17.5	-38.8	42.5	97.7	2.299
208	Min P	STR 1/ 2	29.7	13.7	-28.6	31.7	95.8	3.018
Joint	Min Mx	STR 1/ 2	29.7	13.7	-28.6	31.7	95.8	3.018
209	Min My	STR 1/ 1	39.4	17.5	-38.8	42.5	97.7	2.299
	Min M	STR 1/ 2	29.7	13.7	-28.6	31.7	95.8	3.018

MIN C/D =	**2.299**
CHECK	**OK**

14"x14" Canopy Support Post - South Plaza - Top of Column - Strength III								
Section, Member & Joint	**STR 3 Results**	**Combo ID**	**Pu (kips)**	**Mux (ft*kip)**	**Muy (ft*kip)**	**Mu (ft*kip)**	**ϕMn (ft*kip)**	**ϕMn/Mu**
	Max P	STR 3/ 1	38.8	11.7	48.7	50.1	104.6	2.086
Section ID	Max Mx	STR 3/ 2	32.1	15.1	29.0	32.7	95.2	2.914
Cross Section 1	Max My	STR 3/ 1	38.8	11.7	48.7	50.1	104.6	2.086
Member	Max M	STR 3/ 1	38.8	11.7	48.7	50.1	104.6	2.086
207	Min P	STR 3/ 10	14.4	1.1	14.7	14.8	107.3	7.270
Joint	Min Mx	STR 3/ 9	21.2	-1.6	34.5	34.5	112.3	3.256
208	Min My	STR 3/ 10	14.4	1.1	14.7	14.8	107.3	7.270
	Min M	STR 3/ 10	14.4	1.1	14.7	14.8	107.3	7.270
	Max P	STR 3/ 2	37.3	11.7	-46.5	47.9	104.0	2.169
Section ID	Max Mx	STR 3/ 1	30.6	14.6	-27.0	30.7	94.6	3.080
Cross Section 1	Max My	STR 3/ 9	12.9	1.0	-12.6	12.6	106.8	8.470
Member	Max M	STR 3/ 2	37.3	11.7	-46.5	47.9	104.0	2.169
208	Min P	STR 3/ 9	12.9	1.0	-12.6	12.6	106.8	8.470
Joint	Min Mx	STR 3/ 10	19.8	-2.4	-32.0	32.1	111.5	3.472
209	Min My	STR 3/ 2	37.3	11.7	-46.5	47.9	104.0	2.169
	Min M	STR 3/ 9	12.9	1.0	-12.6	12.6	106.8	8.470

MIN C/D =	**2.086**
CHECK	**OK**

14"x14" Canopy Support Post - South Plaza - Top of Column - Strength V								
Section, Member & Joint	**STR 5 Results**	**Combo ID**	**Pu (kips)**	**Mux (ft*kip)**	**Muy (ft*kip)**	**Mu (ft*kip)**	**ϕMn (ft*kip)**	**ϕMn/Mu**
	Max P	STR 5/ 1	39.2	15.9	40.5	43.5	99.3	2.283
Section ID	Max Mx	STR 5/ 3	38.2	16.9	37.3	40.9	97.5	2.383
Cross Section 1	Max My	STR 5/ 1	39.2	15.9	40.5	43.5	99.3	2.283
Member	Max M	STR 5/ 1	39.2	15.9	40.5	43.5	99.3	2.283
207	Min P	STR 5/ 5	28.0	12.8	26.3	29.3	95.3	3.252
Joint	Min Mx	STR 5/ 4	29.5	12.2	30.4	32.8	97.7	2.984
208	Min My	STR 5/ 5	28.0	12.8	26.3	29.3	95.3	3.252
	Min M	STR 5/ 5	28.0	12.8	26.3	29.3	95.3	3.252
	Max P	STR 5/ 2	38.9	16.0	-40.4	43.5	99.1	2.280
Section ID	Max Mx	STR 5/ 3	38.1	17.0	-37.5	41.1	97.5	2.369
Cross Section 1	Max My	STR 5/ 4	27.7	12.9	-26.3	29.3	95.2	3.247
Member	Max M	STR 5/ 2	38.9	16.0	-40.4	43.5	99.1	2.280
208	Min P	STR 5/ 4	27.7	12.9	-26.3	29.3	95.2	3.247
Joint	Min Mx	STR 5/ 5	29.2	12.2	-30.3	32.7	97.6	2.986
209	Min My	STR 5/ 2	38.9	16.0	-40.4	43.5	99.1	2.280
	Min M	STR 5/ 4	27.7	12.9	-26.3	29.3	95.2	3.247

MIN C/D =	**2.280**
CHECK	**OK**

Section V

Elastomeric Bearings

Design Summary

Project: FIU Pedestrian Bridge

Project No. : 2262.03

Design Task: Elastomeric Bearing Design Summary

Designer: Erika N. Hango, P.E.

Design Summary:

This section contains the calculations performed for the 90% design of the steel-reinforced elastomeric bearings. The calculations were prepared in accordance with the project design criteria, AASHTO LRFD Bridge Design Specifications 7th Edition with 2015 Interim Revisions, FDOT Structures Design Guidelines (January 2015), and AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges 2nd Edition (2009). The intent of this design was to determine the required bearing pad dimensions and the steel reinforcement requirements.

The bridge was modeled using LARSA 4D (V7.08.05). Bearing reactions, deformations, and rotations were extracted from the model. Load combinations were calculated by hand to determine the governing factored loads for design. The Service I limit state was investigated.

The average compressive stress was limited to 1.20 ksi per FIGG Design Directive No. 24. Bearing design was performed in accordance with AASHTO LRFD Method B. The bearing height and number of elastomer layers was determined in accordance with AASHTO LRFD 14.7.5.1. Shear deformation was checked per AASHTO LRFD 14.7.5.3.2. Combined compression, rotation, and shear were checked per AASHTO LRFD 14.7.5.3.3. Stability was checked per AASHTO LRFD 14.7.5.3.4. The steel reinforcement thickness was determined in accordance with AASHTO LRFD 14.7.5.3.5. Compressive deflection was checked per AASHTO LRFD 14.7.5.3.6. Anchorage of bearings without bonded external plates was checked per AASHTO LRFD 14.7.5.4. In addition, bearing stress on concrete was checked at the Strength I limit state per AASHTO LRFD 5.7.5.

Summary Table 1	
Bearing Pad Dimensions	16” x 40”
Number and Thickness of Internal Elastomer Layers	4 @ 5/8”
Number and Thickness of External Elastomer Layers	2 @ 3/8”
Number and Thickness of Internal Steel Layers	5 @ 1/8”

LOADS @ BEARINGS
PIER 1 (SOUTH END)

	Bearing	FX (kips)	FY (kips)	FZ (kips)
DC_EOC	Left	-10	1	-456
	Right	-10	1	-456
CR_EOC	Left	6	0	11
	Right	6	0	11
SH_EOC	Left	2	0	-4
	Right	2	0	-4
PT_EOC	Left	12	0	43
	Right	12	0	43
DC_D10K	Left	-10	1	-456
	Right	-10	1	-456
CR_D10K	Left	9	0	14
	Right	9	0	14
SH_D10K	Left	9	0	-55
	Right	9	0	-55
PT_D10K	Left	11	0	46
	Right	11	0	46
DW	Left	0	0	-21
	Right	0	0	-21
LL DECK_FULL	Left	-1	0	-76
	Right	-1	0	-76
LL DECK_MAIN	Left	-2	0	-86
	Right	-2	0	-86
LL DECK_BACK	Left	0	0	10
	Right	0	0	10
LL ROOF_FULL	Left	0	0	-9
	Right	0	0	-9
LL ROOF_MAIN	Left	0	0	-10
	Right	0	0	-10
LL ROOF_BACK	Left	0	0	1
	Right	0	0	1
LL OFFSET_FULL	Left	-1	0	-114
	Right	-1	0	38
LL OFFSET_MAIN	Left	-1	0	-120
	Right	-1	0	34
LL OFFSET_BACK	Left	0	0	6
	Right	0	0	3
WS O DEG	Left	0	19	-79
	Right	0	19	79
WS 15 DEG	Left	1	18	-70
	Right	0	18	76
WS 30 DEG	Left	2	16	-61
	Right	1	16	72
WS 45 DEG	Left	2	12	-43
	Right	2	12	59

CR+SH+PT (EOC)		
20	0	50
20	0	50

CR+SH+PT (D10K)		
29	0	5
29	0	5

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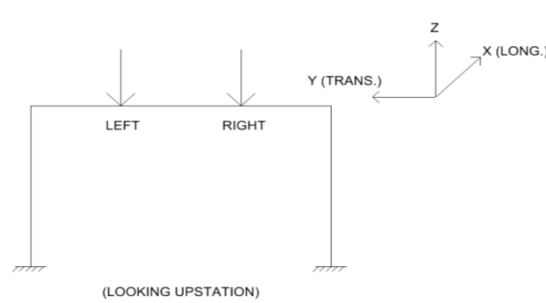
	Checked MF	Date 03-Oct-16		

LOADS @ BEARINGS
PIER 1 (SOUTH END)

	Bearing	FX (kips)	FY (kips)	FZ (kips)	Strength V (x 3.25)			Service I (x 3.33)		
WS 60 DEG	Left	3	7	-20						
	Right	2	7	41						
WS -15 DEG	Left	0	18	-76						
	Right	-1	18	70						
WS -30 DEG	Left	-1	16	-72						
	Right	-2	16	61						
WS -45 DEG	Left	-2	12	-60						
	Right	-2	12	43						
WS -60 DEG	Left	-2	7	-41						
	Right	-3	7	20						
WS O DEG_70 MPH	Left	0	8	-26	1	26	-85	1	27	-87
	Right	0	8	26	-1	26	85	-1	27	87
WS 15 DEG_70 MPH	Left	0	7	-23	1	24	-75	1	25	-77
	Right	0	7	25	0	24	80	0	25	82
WS 30 DEG_70 MPH	Left	1	7	-21	2	23	-67	2	23	-68
	Right	0	7	24	1	23	77	1	23	79
WS 45 DEG_70 MPH	Left	1	5	-14	3	16	-46	3	17	-48
	Right	1	5	19	2	16	61	2	17	62
WS 60 DEG_70 MPH	Left	1	3	-7	3	9	-23	3	9	-23
	Right	1	3	12	3	9	40	3	9	41
WS -15 DEG_70 MPH	Left	0	7	-25	0	24	-80	0	25	-82
	Right	0	7	23	-1	24	75	-1	25	77
WS -30 DEG_70 MPH	Left	0	7	-24	-1	23	-77	-1	23	-79
	Right	-1	7	20	-2	23	67	-2	23	68
WS -45 DEG_70 MPH	Left	-1	5	-19	-2	16	-61	-2	17	-62
	Right	-1	5	14	-3	16	46	-3	17	48
WS -60 DEG_70 MPH	Left	-1	3	-12	-3	9	-40	-3	9	-41
	Right	-1	3	7	-3	9	23	-3	9	23
WS+WUP	Left	1	19	-97						
	Right	0	19	151						
TU+	Left	-10	0	-35						
	Right	-10	0	-35						
TU-	Left	10	0	35						
	Right	10	0	35						
TU + TEMP. DIFF.	Left	-11	0	-69						
	Right	-11	0	-69						



Notes:
1. Loads are unfactored.
2. LL Offset load case considers pedestrian live load
3. The 70 mph wind load cases apply to Service I and
4. (-) for axial bearing load denotes compression.

Sum-It: AASHTO LRFD Load Combination Generator
Figg Bridge Engineers, Inc.
Combined Limit States Results
File Name: Pier 1 Bearing Reactions.sum

Selected Limit States

STR 1 - STRENGTH I
STR 3 - STRENGTH III
STR 5 - STRENGTH V

	Combined Results										
	Max/ Min ID	**Combo ID**	**Fx (kips)**	**Fy (kips)**	**Fz (kips)**	**Mx (ft*kip)**	**My (ft*kip)**	**Mz (ft*kip)**	**Mxy (ft*kip)**	**Mxz (ft*kip)**	**Myz (ft*kip)**
Load No. 1 **Member** Left **Joint** Left	Max Fx	STR 3/ 159	29.2	10.7	-447.4	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fy	STR 3/ 5	12.5	27.9	-644.6	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fz	STR 1/ 165	16.0	0.9	-339.1	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mx	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max My	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxy	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Myz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fx	STR 5/ 193	-1.9	4.9	-718.1	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fy	STR 1/ 55	14.3	0.9	-507.4	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fz	STR 1/ 53	9.3	1.3	-841.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mx	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min My	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxy	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Myz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
Load No. 2 **Member** Right **Joint** Right	Max Fx	STR 3/ 158	27.8	17.7	-336.8	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fy	STR 3/ 5	12.5	27.9	-423.4	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fz	STR 3/ 190	16.0	27.5	-145.2	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mx	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max My	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxy	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Myz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fx	STR 3/ 24	-2.2	11.1	-558.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fy	STR 1/ 55	14.3	0.9	-507.4	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fz	STR 1/ 47	7.5	1.3	-781.5	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mx	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min My	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxy	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Myz	STR 1/ 1	10.8	1.3	-667.0	0.0	0.0	0.0	0.0	0.0	0.0

Sum-It: AASHTO LRFD Load Combination Generator
Figg Bridge Engineers, Inc.
Combined Limit States Results
File Name: Pier 1 Bearing Reactions.sum

Selected Limit States
SRV 1 - SERVICE I
SRV 3 - SERVICE III

	Combined Results										
	Max/ Min ID	**Combo ID**	**Fx (kips)**	**Fy (kips)**	**Fz (kips)**	**Mx (ft*kip)**	**My (ft*kip)**	**Mz (ft*kip)**	**Mxy (ft*kip)**	**Mxz (ft*kip)**	**Myz (ft*kip)**
	Max Fx	SRV 1/ 309	29.9	6.1	-460.4	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fy	SRV 1/ 37	19.3	9.1	-494.1	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fz	SRV 3/ 7	20.0	1.0	-384.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mx	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
	Max My	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
Load No.	Max Mz	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
1	Max Mxy	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxz	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
Member	Max Myz	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
Left	Min Fx	SRV 1/ 193	-3.9	3.7	-594.3	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fy	SRV 3/ 1	19.2	1.0	-452.8	0.0	0.0	0.0	0.0	0.0	0.0
Joint	Min Fz	SRV 1/ 446	7.3	9.1	-687.1	0.0	0.0	0.0	0.0	0.0	0.0
Left	Min Mx	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
	Min My	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mz	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxy	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxz	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
	Min Myz	SRV 1/ 1	19.0	8.5	-492.6	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fx	SRV 1/ 318	29.9	3.7	-433.7	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fy	SRV 1/ 37	18.7	9.1	-441.9	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fz	SRV 1/ 38	18.7	9.1	-327.9	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mx	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
	Max My	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
Load No.	Max Mz	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
2	Max Mxy	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxz	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
Member	Max Myz	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
Right	Min Fx	SRV 1/ 184	-3.9	6.1	-567.6	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fy	SRV 3/ 1	19.2	1.0	-452.8	0.0	0.0	0.0	0.0	0.0	0.0
Joint	Min Fz	SRV 1/ 436	5.1	3.7	-620.1	0.0	0.0	0.0	0.0	0.0	0.0
Right	Min Mx	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
	Min My	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mz	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxy	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxz	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0
	Min Myz	SRV 1/ 1	18.7	8.5	-444.9	0.0	0.0	0.0	0.0	0.0	0.0

Figg Bridge Engineers, Inc.	Project: FIU - Pedestrian Bridge			Creating Bridges as Art
	Designed: EDL	Project No.: 2262.03	Sheet: of	
Tallahassee Denver Philadelphia Dallas	Checked:	Date: 05-Oct-16		

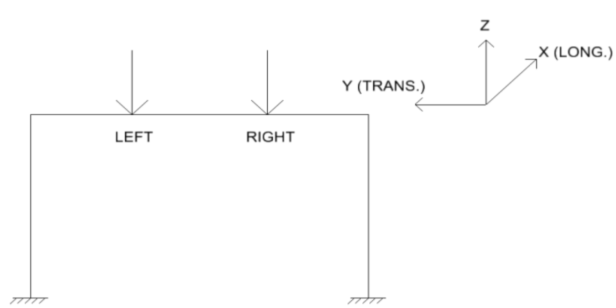
DISPLACEMENTS AND ROTATIONS @ BEARINGS
PIER 1 (SOUTH END)

	Bearing	Translation X (in)	Translation Y (in)	Translation Z (in)	Rotation X (rad)	Rotation Y (rad)	Rotation Z (rad)
DC_EOC	Left	-0.4671	0.0407	-0.2095	0.0000	0.0036	0.0000
	Right	-0.4692	0.0407	-0.2084	0.0000	0.0036	0.0000
CR_EOC	Left	0.3163	-0.0014	0.0001	0.0000	0.0022	0.0000
	Right	0.3164	-0.0014	0.0001	0.0000	0.0022	0.0000
SH_EOC	Left	0.0959	0.0003	-0.0022	0.0000	0.0001	0.0000
	Right	0.0958	0.0003	-0.0022	0.0000	0.0001	0.0000
PT_EOC	Left	0.5685	-0.0046	0.0152	0.0000	-0.0003	0.0000
	Right	0.5687	-0.0046	0.0152	0.0000	-0.0003	0.0000
DC_D10K	Left	-0.4671	0.0407	-0.2095	0.0000	0.0036	0.0000
	Right	-0.4692	0.0407	-0.2084	0.0000	0.0036	0.0000
CR_D10K	Left	0.4414	-0.0020	0.0000	0.0000	0.0031	0.0000
	Right	0.4416	-0.0020	0.0000	0.0000	0.0031	0.0000
SH_D10K	Left	0.3942	0.0048	-0.0257	0.0000	0.0004	0.0000
	Right	0.3939	0.0048	-0.0255	0.0000	0.0004	0.0000
PT_D10K	Left	0.5434	-0.0048	0.0165	0.0000	-0.0003	0.0000
	Right	0.5437	-0.0048	0.0165	0.0000	-0.0003	0.0000
DW	Left	-0.0149	0.0013	-0.0089	0.0000	0.0002	0.0000
	Right	-0.0150	0.0013	-0.0088	0.0000	0.0002	0.0000
LL DECK_FULL	Left	-0.0545	0.0047	-0.0325	0.0000	0.0007	0.0000
	Right	-0.0548	0.0047	-0.0323	0.0000	0.0007	0.0000
LL DECK_MAIN	Left	-0.0760	0.0038	-0.0367	0.0000	0.0008	0.0000
	Right	-0.0762	0.0038	-0.0365	0.0000	0.0008	0.0000
LL DECK_BACK	Left	0.0214	0.0010	0.0042	0.0000	-0.0001	0.0000
	Right	0.0214	0.0010	0.0042	0.0000	-0.0001	0.0000
LL ROOF_FULL	Left	-0.0078	0.0005	-0.0039	0.0000	0.0001	0.0000
	Right	-0.0079	0.0005	-0.0039	0.0000	0.0001	0.0000
LL ROOF_MAIN	Left	-0.0094	0.0004	-0.0043	0.0000	0.0001	0.0000
	Right	-0.0094	0.0004	-0.0043	0.0000	0.0001	0.0000
LL ROOF_BACK	Left	0.0016	0.0001	0.0004	0.0000	0.0000	0.0000
	Right	0.0015	0.0001	0.0004	0.0000	0.0000	0.0000
LL OFFSET_FULL	Left	-0.0275	0.0056	-0.0252	-0.0001	0.0004	0.0000
	Right	-0.0271	0.0056	-0.0074	-0.0001	0.0004	0.0000
LL OFFSET_MAIN	Left	-0.0379	0.0030	-0.0275	-0.0002	0.0004	0.0000
	Right	-0.0381	0.0030	-0.0093	-0.0002	0.0004	0.0000
LL OFFSET_BACK	Left	0.0104	0.0026	0.0023	0.0000	0.0000	0.0000
	Right	0.0110	0.0026	0.0019	0.0000	0.0000	0.0000
WS O DEG	Left						
	Right						
WS 15 DEG	Left						
	Right						
WS 30 DEG	Left						
	Right						
WS 45 DEG	Left						
	Right						
WS 60 DEG	Left						
	Right						

DISPLACEMENTS AND ROTATIONS @ BEARINGS
PIER 1 (SOUTH END)

	Bearing	Translation X (in)	Translation Y (in)	Translation Z (in)	Rotation X (rad)	Rotation Y (rad)	Rotation Z (rad)
WS -15 DEG	Left						
	Right						
WS -30 DEG	Left						
	Right						
WS -45 DEG	Left						
	Right						
WS -60 DEG	Left						
	Right						
WS O DEG_70 MPH	Left	0.0078	0.3441	-0.0034	0.0000	0.0000	-0.0001
	Right	-0.0077	0.3441	0.0021	0.0000	0.0000	-0.0001
WS 15 DEG_70 MPH	Left	0.0182	0.3173	-0.0029	0.0000	0.0000	-0.0001
	Right	0.0039	0.3173	0.0021	0.0000	0.0000	-0.0001
WS 30 DEG_70 MPH	Left	0.0315	0.2972	-0.0024	0.0000	0.0000	-0.0001
	Right	0.0180	0.2972	0.0022	0.0000	0.0000	-0.0001
WS 45 DEG_70 MPH	Left	0.0410	0.2158	-0.0014	0.0000	0.0000	-0.0001
	Right	0.0313	0.2158	0.0020	0.0000	0.0000	-0.0001
WS 60 DEG_70 MPH	Left	0.0461	0.1163	-0.0004	0.0000	0.0000	0.0000
	Right	0.0411	0.1163	0.0017	0.0000	0.0000	0.0000
WS -15 DEG_70 MPH	Left	-0.0038	0.3173	-0.0033	0.0000	0.0000	-0.0001
	Right	-0.0181	0.3173	0.0016	0.0000	0.0000	-0.0001
WS -30 DEG_70 MPH	Left	-0.0180	0.2972	-0.0034	0.0000	0.0000	-0.0001
	Right	-0.0314	0.2972	0.0012	0.0000	0.0000	-0.0001
WS -45 DEG_70 MPH	Left	-0.0313	0.2159	-0.0029	0.0000	0.0000	-0.0001
	Right	-0.0410	0.2159	0.0005	0.0000	0.0000	-0.0001
WS -60 DEG_70 MPH	Left	-0.0410	0.1164	-0.0021	0.0000	0.0000	0.0000
	Right	-0.0461	0.1164	-0.0001	0.0000	0.0000	0.0000
WS+WUP	Left						
	Right						
TU+	Left	-0.4530	0.0031	-0.0129	0.0000	0.0002	0.0000
	Right	-0.4532	0.0031	-0.0129	0.0000	0.0002	0.0000
TU-	Left	0.4530	-0.0031	0.0129	0.0000	-0.0002	0.0000
	Right	0.4532	-0.0031	0.0129	0.0000	-0.0002	0.0000
TU + TEMP. DIFF.	Left	-0.4725	0.0060	-0.0273	0.0000	0.0004	0.0000
	Right	-0.4728	0.0060	-0.0272	0.0000	0.0004	0.0000

Notes:
1. Values are unfactored.
2. LL Offset load case considers pedestrian live load only on one side of the bridge deck.
3. The 70 mph wind load cases apply to Service I and Strength V limit states per SDG.



DISPLACEMENTS AND ROTATIONS @ BEARINGS
PIER 1 (SOUTH END)

$\Delta_s = 0.65\Delta_T + \Delta_{CR,SH,PT}$		
Load Case	**Bearing**	**Translation X (in)**
$\Delta_{CR,SH,PT}$ (LT - EOC)	Left	0.3984
	Right	0.3982
Δ_T (Fall - Rise)	Left	0.9061
	Right	0.9065
Δ_s	Left	0.9874
	Right	0.9874

Service I (Static)			
Load Case	**Bearing**	**Translation X (in)**	**Rotation Y (rad)**
$\Delta_{CR,SH,PT}$ (LT - EOC)	Left	0.3984	0.0011
	Right	0.3982	0.0011
$\Delta_{DC} + \Delta_{DW}$	Left	-0.4820	0.0038
	Right	-0.4841	0.0038
$\Delta_{s,st}$ & $\theta_{s,st}$	Left	-0.0835	0.0050
	Right	-0.0859	0.0050

Service I (Cyclic) = LL + WS + 1.20 x TU			
Load Case	**Bearing**	**Translation X (in)**	**Rotation Y (rad)**
LL Deck Main, WS 0 deg, +TU	Left	-0.6118	0.0010
	Right	-0.6278	0.0010
LL Deck Main, WS 0 deg, -TU	Left	0.4755	0.0006
	Right	0.4599	0.0006
LL Deck Main, WS 0 deg, TU+Temp Diff	Left	-0.6351	0.0013
	Right	-0.6513	0.0013
LL Deck Main, WS 15 deg, +TU	Left	-0.6014	0.0010
	Right	-0.6162	0.0010
LL Deck Main, WS 15 deg, -TU	Left	0.4859	0.0006
	Right	0.4716	0.0006
LL Deck Main, WS 15 deg, TU+Temp Diff	Left	-0.6247	0.0013
	Right	-0.6397	0.0013
LL Deck Main, WS 30 deg, +TU	Left	-0.5881	0.0010
	Right	-0.6020	0.0010
LL Deck Main, WS 30 deg, -TU	Left	0.4992	0.0005
	Right	0.4857	0.0005
LL Deck Main, WS 30 deg, TU+Temp Diff	Left	-0.6114	0.0013
	Right	-0.6255	0.0013
LL Deck Main, WS 45 deg, +TU	Left	-0.5786	0.0010
	Right	-0.5887	0.0010
LL Deck Main, WS 45 deg, -TU	Left	0.5087	0.0005
	Right	0.4990	0.0005
LL Deck Main, WS 45 deg, TU+Temp Diff	Left	-0.6019	0.0013
	Right	-0.6122	0.0013
LL Deck Main, WS 60 deg, +TU	Left	-0.5735	0.0010
	Right	-0.5790	0.0010

DISPLACEMENTS AND ROTATIONS @ BEARINGS
PIER 1 (SOUTH END)

LL Deck Main, WS 60 deg, -TU	Left	0.5138	0.0005
	Right	0.5087	0.0005
LL Deck Main, WS 60 deg, TU+Temp Diff	Left	-0.5968	0.0013
	Right	-0.6025	0.0013
LL Deck Main, WS - 15 deg, +TU	Left	-0.6234	0.0010
	Right	-0.6382	0.0010
LL Deck Main, WS - 15 deg, -TU	Left	0.4639	0.0006
	Right	0.4496	0.0006
LL Deck Main, WS - 15 deg, TU+Temp	Left	-0.6467	0.0013
	Right	-0.6617	0.0013
LL Deck Main, WS - 30 deg, +TU	Left	-0.6376	0.0010
	Right	-0.6515	0.0010
LL Deck Main, WS - 30 deg, -TU	Left	0.4497	0.0006
	Right	0.4362	0.0006
LL Deck Main, WS - 30 deg, TU+Temp	Left	-0.6609	0.0013
	Right	-0.6750	0.0013
LL Deck Main, WS - 45 deg, +TU	Left	-0.6509	0.0010
	Right	-0.6610	0.0010
LL Deck Main, WS - 45 deg, -TU	Left	0.4364	0.0006
	Right	0.4267	0.0006
LL Deck Main, WS - 45 deg, TU+Temp	Left	-0.6742	0.0013
	Right	-0.6845	0.0013
LL Deck Main, WS - 60 deg, +TU	Left	-0.6606	0.0011
	Right	-0.6661	0.0011
LL Deck Main, WS - 60 deg, -TU	Left	0.4267	0.0006
	Right	0.4216	0.0006
LL Deck Main, WS - 60 deg, TU+Temp	Left	-0.6839	0.0013
	Right	-0.6896	0.0013

References: Project Design Criteria
AASHTO LRFD Bridge Design Specifications, 7th Edition, 2014
FDOT SDG, January 2015

AASHTO LRFD 14.7.5 Method B - Design Procedure for Steel-Reinforced Elastomeric Bearings

Pier No. P1

STEP 1: Enter Bearing Loads

	D10K	
P_{st} =	472 kips	Service load corresponding to maximum total compressive load due to static loads = DC + DW + CR + SH + PT
P_{cy} =	215 kips	Service load corresponding to maximum total compressive load due to cyclic loads = LL + WS + TU (includes multiple presence factor and dynamic load allowance)
$P_s = P_{st} + P_{cy}$ =	687 kips	Maximum service compressive load due to total load
P_{LL} =	120 kips	Service load corresponding to maximum total compressive load due to live load (includes multiple presence factor and dynamic load allowance)
P_{DL} =	477 kips	Service load corresponding to maximum total compressive load due to dead load = DC + DW

STEP 2: Enter Bearing Deflections

Δ_s =	0.99 in.	Maximum total shear deformation of the bearing at the service limit state = 0.65 x temp range + CR + SH + PT (modified for substructure stiffness & construction procedures by use of LARSA). *(LRFD 14.7.5.3.2)* 1.20 load factor not applied per SDG 6.5.1.A.
$\Delta_{s,st}$ =	0.09 in.	Maximum total static shear deformation at the service limit state = DC + DW + CR + SH + PT
$\Delta_{s,cy}$ =	0.69 in.	Maximum total cyclic shear deformation at the service limit state = LL + WS + 1.20 x TU
$\theta_{s,st}$ =	0.01000 rad	Maximum static service limit state design rotation angle = DC + DW + CR + SH + PT + 0.005 rad allowance for uncertainties
$\theta_{s,cy}$ =	0.00630 rad	Maximum cyclic service limit state design rotation angle = LL + WS + 1.20 x TU + 0.005 rad allowance for uncertainties

STEP 3: Specify Bearing Plan Dimensions

	L = Length of bearing parallel to long. axis of bridge		W = Width of bearing parallel to trans. axis of bridge	
Try	16 in.	x	40 in.	Bearing Pad Dimensions
		d_{hole} =	0.00 in.	Diameter of Hole in Bearing
		$A = (L \times W) - \pi/4 \times d_{hole}^2$ =	640 sq. in.	Bearing Area

STEP 4: Specify Bearing Type & Properties

Shape :	RECTANGULAR		
Durometer =	50	*(from Project Design Criteria)*	
G_{min} =	0.080 ksi	Minimum Shear Modulus *(LRFD 14.7.5.2)*	
G_{max} =	0.175 ksi	Maximum Shear Modulus *(LRFD 14.7.5.2)*	
G =	0.110 ksi	Specified Shear Modulus *(SDG 6.5.1.A)*	OKAY

STEP 5: Design for Compressive Stress - Service Limit State *(FIGG Design Directive No. 24)*

Limit average compressive stress to	1.200 ksi			
$\sigma_s = P_S / A$ =	1.074 ksi	Service compressive stress due to total load	< 1.200ksi	OKAY

NOTE: Bearings designed for stresses above 1.0 ksi are subject to additional testing requirements.

STEP 6: Determine Bearing Height & Number of Elastomer Layers *(LRFD 14.7.5.1)*

Use: h_{ri_int} =	0.625 in	Thickness of interior elastomer layer (typical)	
Maximum $h_{ri\_ext} = 0.70 \times h_{ri\_int}$ =	0.438 in.	Maximum allowable thickness of exterior layers	
Use h_{ri_ext} =	0.375 in.	< 0.438 in.	OKAY
Minimum $N_{int} = (h_{rt} - 2 \times h_{ri\_ext}) / h_{ri\_int}$ =	4	Number of interior layers required	
N_{int} =	4	Number of interior layers used	OKAY

STEP 7: Check Shear Deformation - Service Limit State *(LRFD 14.7.5.3.2)*

Minimum $h_{rt} = 2 \times \Delta_s$ =	1.97 in.	Minimum total elastomer thickness		
$h_{rt} = 2 \times h_{ri\_ext} + N_{int} \times h_{ri\_int}$ =	3.25 in.	Provided total elastomer thickness	> 1.975 in.	OKAY

STEP 8: Calculate Shape Factor *(LRFD Eq. 14.7.5.1-1)*

$S_{int} = A / [h_{ri\_int} \times (2 \times L + 2 \times W + \pi \times d_{hole})]$ =	9.14	Shape Factor of Interior Layer *(LRFD Eq. C14.7.5.1-1)*
$S_{ext} = A / [h_{ri\_ext} \times (2 \times L + 2 \times W + \pi \times d_{hole})]$ =	15.24	Shape Factor of Exterior Layer *(LRFD Eq. C14.7.5.1-1)*
S_i =	9.14	Conservatively, use the minimum shape factor.

STEP 9: Check Combined Compression, Rotation, and Shear - Service Limit State *(LRFD 14.7.5.3.3)*

D_a =	1.40	For rectangular bearings *(LRFD Eq. 14.7.5.3.3-4)*		
$\sigma_{s,st} = P_{st} / A$ =	0.738 ksi	Average compressive stress due to total static load		
$\gamma_{a,st} = D_a \times \sigma_{s,st} / (G_{min} \times S_i)$ =	1.41	Shear strain caused by axial load (static)	< 3.00	OKAY
D_r =	0.50	For rectangular bearings *(LRFD Eq. 14.7.5.3.3-7)*		
$\gamma_{r,st} = D_r \times (L / h_{ri\_int})^2 \times (\theta_{s,st} / N_{int})$ =	0.82	Shear strain caused by rotation (static)		
$\gamma_{s,st} = \Delta_{s,st} / h_{rt}$ =	0.03	Shear strain caused by shear deformation (static)		
$\sigma_{s,cy} = P_{cy} / A$ =	0.336 ksi	Average compressive stress due to cyclic load		
$\gamma_{a,cy} = D_a \times \sigma_{s,cy} / (G_{min} \times S_i)$ =	0.64	Shear strain caused by axial load (cyclic)		
$\gamma_{r,cy} = D_r \times (L / h_{ri\_int})^2 \times (\theta_{s,cy} / N_{int})$ =	0.52	Shear strain caused by rotation (cyclic)		
$\gamma_{s,cy} = \Delta_{s,cy} / h_{rt}$ =	0.21	Shear strain caused by shear deformation (cyclic)		
$(\gamma_{a,st} + \gamma_{r,st} + \gamma_{s,st}) + 1.75 \times (\gamma_{a,cy} + \gamma_{r,cy} + \gamma_{s,cy})$ =	4.66	< 5.00	OKAY	

NOTE: When the thickness of an exterior layer is more than 1/2 the thickness of an interior layer, the number of interior layers may be increased by 1/2 for each such exterior layer.

STEP 10: Check Stability of Elastomeric Bearings - Service Limit State (*LRFD 14.7.5.3.4*)
Bearings satisfying LRFD Eq. 14.7.5.3.4-1 shall be considered stable, and no further investigation of stability is required.

$A = 1.92 \times (h_{rt} / L) / \sqrt{(1 + 2.0 \times L / W)}$ =	0.291		
$B = 2.67 / [(S_i + 2.0) \times (1 + L / (4 \times W)]$ =	0.218		
2A =	0.581	> B	CHECK STRESSES

For rectangular bearings not satisfying LRFD Eq. 14.7.5.3.4-1:

Sway = 0 — If bridge is free to translate horizontally, sway = 0. If bridge is fixed against horizontal translation at any point, sway = 1.

$G_{min} \times S_i / (2 \times A - B)$ =	2.012 ksi	Bridge free to translate horizontally		
$G_{min} \times S_i / (A - B)$ =	10.039 ksi	Bridge fixed against horizontal translation		
$\sigma_s = P_S / A$ =	1.074 ksi	Service compressive stress due to total load	< 2.012 ksi	OKAY

STEP 11: Determine Steel Reinforcement Thickness *(LRFD 14.7.5.3.5)*

Service Limit State:

F_y =	36 ksi	Yield strength of steel reinforcement	
$\sigma_s = P_S / A$ =	1.074 ksi	Service compressive stress due to total load	
Minimum $h_s = MAX(3 \times h_{ri\_int} \times \sigma_s / F_y , 1/16")$ =	0.0625 in	Minimum thickness of steel reinforcement for service limit state	
h_s =	0.1250 in.	Provided thickness of steel reinforcement	OKAY

Fatigue Limit State:

ΔF_{TH} =	24 ksi	Constant amplitute fatigue threshold for Category A (*LRFD Table 6.6.1.2.3-1)*	
$\sigma_L = P_{LL} / A$	0.188 ksi	Service compressive stress due to live load	
Minimum $h_s = MAX(2 \times h_{ri\_int} \times \sigma_L / \Delta F_{TH} , 1/16")$ =	0.0625 in	Minimum thickness of steel reinforcement for fatigue limit state	
h_s =	0.1250 in.	Provided thickness of steel reinforcement	OKAY

STEP 12: Check Compressive Deflection - Service Limit State *(LRFD 14.7.5.3.6)*

Instantaneous Live Load Deflection:

δ_{all} =	0.125 in.	Maximum relative live load deflection deflection across joint *(LRFD C14.7.5.3.6)*
$\sigma_{Li} = P_{LL} / A$ =	0.188 ksi	Instantaneous live load compressive stress in an individual elastomer layer
$\varepsilon_{Li} = \sigma_{Li} / (4.8 \times G_{min} \times S_i^2)$ =	0.006	Instantaneous live load compressive strain in *i*th elastomer layer *(LRFD Eq. C14.7.5.3.6-1)*
$\delta_L = \varepsilon_{Li} \times (2 \times h_{ri\_ext} + N_{int} \times h_{ri\_int})$ =	0.019 in.	Instantaneous live load deflection **< 0.125 in.** OKAY

Initial Dead Load Deflection :

$\sigma_{di} = P_{DL} / A$ =	0.745 ksi	Instantaneous dead load compressive stress in an individual elastomer layer
$\varepsilon_{di} = \sigma_{di} / (4.8 \times G_{min} \times S_i^2)$ =	0.023	Instantaneous dead load compressive strain in *i*th elastomer layer *(LRFD Eq. C14.7.5.3.6-1)*
$\delta_d = \varepsilon_{di} \times (2 \times h_{ri\_ext} + N_{int} \times h_{ri\_int})$ =	0.075 in.	Initial dead load deflection

Long-Term Dead Load Deflection:

a_{cr} =	0.25	Creep deflection divided by initial dead load deflection *(LRFD Table 14.7.6.2-1)*
$\delta_{lt} = \delta_d + a_{cr} \times \delta_d$ =	0.094 in.	Long-term dead load deflection

Instantaneous Live Load Deflection + Initial Dead Load Deflection:

$\delta_{all} = 0.09 \times h_{ri\_int}$ =	0.056 in.	Allowable compressive deflection under instantaneous live load and initial dead load *(LRFD 14.7.6.3.3)*
$\delta_{Li} = \varepsilon_{Li} \times h_{ri\_int}$ =	0.004 in.	Compressive deflection of an internal layer under instantaneous live load
$\delta_{di} = \varepsilon_{di} \times h_{ri\_int}$ =	0.015 in.	Compressive deflection of an internal layer under initial dead load
$\delta_{Li} + \delta_{di}$ =	0.018 in.	Compressive deflection under instant. live load and initial dead load **< 0.056 in.** OKAY

STEP 13: Check Anchorage for Bearings without Bonded External Plates - Service Limit State *(LRFD 14.7.5.4)*

$\theta_s = \theta_{s,st} + 1.75 \times \theta_{s,cy}$ =	0.02103 rad	Total static and cyclic design rotation angle (cyclic component is multiplied by 1.75)
$P_a = P_{st} + 1.75 \times P_{cy}$ =	848 kips	Total static and cyclic axial load (cyclic component is multiplied by 1.75)
$\sigma_a = P_a / A$ =	1.326 ksi	Total static and cyclic average axial stress (cyclic component is multiplied by 1.75)
$\varepsilon_a = \sigma_a / (4.8 \times G_{min} \times S_i^2)$ =	0.041	Total static and cyclic average axial strain (cyclic component is multiplied by 1.75)
$3 \times \varepsilon_a / S_i$ =	0.014	
θ_s / N_{int} =	0.005	RESTRAINT SYSTEM NOT REQUIRED

NOTE: When the thickness of an exterior layer is more than 1/2 the thickness of an interior layer, the number of interior layers may be increased by 1/2 for each such exterior layer.

STEP 14: Check Bearing Stress on Concrete - Strength Limit State ***(LRFD 5.7.5)***

f'_c =	5.5 ksi	Compressive strength of substructure
ϕ_b =	0.70	Strength reduction factor for bearing on concrete *(LRFD 5.5.4.2.1)*
A_1 =	640 sq. in.	Area of bearing
A_2 =	640 sq. in.	Assume 90° distribution angle unless greater A2 is needed
$m = \mathrm{MIN}[\sqrt{(A_2 / A_1)}, 2]$ =	1.00	
$\phi_b P_n = \phi_b \times 0.85 \times f'_c \times A_1 \times m$ =	2,094 kips	*(LRFD Eq. 5.7.5-2)*
P_u (Strength I) =	841 kips	**< 2094 kips** OKAY

Summary of Bearing	P1	
Bearing Pad Dimensions =	16 in.	x 40 in.
Use	4	5/8" Internal Layers of Elastomer
	2	3/8" External Layers of Elastomer
	5	1/8" Internal Layers of Steel
Total Bearing Ht =	**3.875 in.**	

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	Designed: EDL	Project No.: 2262.03	Sheet of	
Tallahassee Denver Philadelphia Dallas	Checked: MF	Date: 03-Oct-16		

LOADS @ BEARINGS
PIER 3 (NORTH END)

	Bearing	FX (kips)	FY (kips)	FZ (kips)
DC_EOC	Left	1	0	-333
	Right	1	0	-333
CR_EOC	Left	-4	0	16
	Right	-4	0	16
SH_EOC	Left	-1	0	-6
	Right	-1	0	-6
PT_EOC	Left	-6	0	70
	Right	-6	0	70
DC_D10K	Left	1	0	-333
	Right	1	0	-333
CR_D10K	Left	-6	0	21
	Right	-6	0	21
SH_D10K	Left	-5	0	-98
	Right	-5	0	-98
PT_D10K	Left	-5	0	75
	Right	-5	0	75
DW	Left	0	0	-5
	Right	0	0	-5
LL DECK_FULL	Left	-1	0	-19
	Right	-1	0	-19
LL DECK_MAIN	Left	-1	0	52
	Right	-1	0	52
LL DECK_BACK	Left	0	0	-71
	Right	0	0	-71
LL ROOF_FULL	Left	0	0	0
	Right	0	0	0
LL ROOF_MAIN	Left	0	0	6
	Right	0	0	6
LL ROOF_BACK	Left	0	0	-6
	Right	0	0	-6
LL OFFSET_FULL	Left	0	0	-61
	Right	0	0	42
LL OFFSET_MAIN	Left	0	0	32
	Right	0	0	20
LL OFFSET_BACK	Left	0	0	-93
	Right	0	0	22
WS O DEG	Left	0	1	-48
	Right	0	1	48
WS 15 DEG	Left	1	1	-50
	Right	0	1	39
WS 30 DEG	Left	1	1	-52
	Right	1	1	29
WS 45 DEG	Left	2	1	-48
	Right	2	1	15

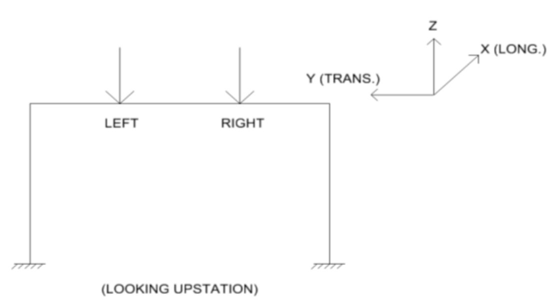
CR+SH+PT (EOC)		
-11	0	80
-11	0	80

CR+SH+PT (D10K)		
-17	0	-1
-17	0	-1

Figg Bridge Engineers, Inc.	Project: FIU - Pedestrian Bridge			Creating Bridges as Art
Tallahassee Denver Philadelphia Dallas	Designed: EDL	Project No.: 2262.03	Sheet of	
	Checked: MF	Date: 03-Oct-16		

LOADS @ BEARINGS
PIER 3 (NORTH END)

	Bearing	FX (kips)	FY (kips)	FZ (kips)	Strength V (x 3.25)			Service I (x 3.33)		
WS 60 DEG	Left	2	1	-39						
	Right	2	1	-1						
WS -15 DEG	Left	0	1	-38						
	Right	-1	1	49						
WS -30 DEG	Left	-1	1	-28						
	Right	-1	1	51						
WS -45 DEG	Left	-2	1	-14						
	Right	-2	1	48						
WS -60 DEG	Left	-2	1	1						
	Right	-2	1	39						
WS O DEG_70 MPH	Left	0	0	-14	0	0	-47	0	0	-48
	Right	0	0	14	0	0	47	0	0	48
WS 15 DEG_70 MPH	Left	0	0	-15	1	0	-48	1	0	-49
	Right	0	0	12	0	0	38	1	0	39
WS 30 DEG_70 MPH	Left	1	0	-16	2	0	-51	2	0	-52
	Right	0	0	9	1	0	29	1	0	29
WS 45 DEG_70 MPH	Left	1	0	-14	3	0	-46	3	0	-47
	Right	1	0	4	2	0	15	2	0	15
WS 60 DEG_70 MPH	Left	1	0	-11	3	0	-37	3	0	-38
	Right	1	0	0	3	0	-1	3	0	-1
WS -15 DEG_70 MPH	Left	0	0	-12	0	0	-38	-1	0	-39
	Right	0	0	15	-1	0	48	-1	0	49
WS -30 DEG_70 MPH	Left	0	0	-9	-1	0	-29	-1	0	-30
	Right	-1	0	16	-2	0	50	-2	0	52
WS -45 DEG_70 MPH	Left	-1	0	-5	-2	0	-15	-2	0	-15
	Right	-1	0	14	-3	0	46	-3	0	47
WS -60 DEG_70 MPH	Left	-1	0	0	-3	0	1	-3	0	1
	Right	-1	0	11	-3	0	37	-3	0	38
WS+WUP	Left	0	1	-69						
	Right	0	1	78						
TU+	Left	6	0	-64						
	Right	6	0	-64						
TU-	Left	-6	0	64						
	Right	-6	0	64						
TU + TEMP. DIFF.	Left	6	0	-124						
	Right	6	0	-124						



Notes:
1. Loads are unfactored.
2. LL Offset load case considers pedestrian live load
3. The 70 mph wind load cases apply to Service I and
4. (-) for axial bearing load denotes compression.

Sum-It: AASHTO LRFD Load Combination Generator
Figg Bridge Engineers, Inc.
Combined Limit States Results
File Name: Pier 3 Bearing Reactions.sum

Selected Limit States

STR 1 - STRENGTH I
STR 3 - STRENGTH III
STR 5 - STRENGTH V

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
Load No. 1 **Member** Left **Joint** Left	Max Fx	STR 3/ 18	-4.0	1.4	-443.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fy	STR 3/ 1	-12.8	1.4	-365.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fz	STR 1/ 164	-14.9	0.0	-100.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mx	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max My	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxy	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Myz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fx	STR 3/ 153	-21.9	1.4	-295.8	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fy	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fz	STR 1/ 54	-12.8	0.0	-649.5	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mx	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min My	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxy	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Myz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
Load No. 2 **Member** Right **Joint** Right	Max Fx	STR 3/ 18	-4.0	1.4	-354.8	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fy	STR 3/ 1	-14.2	1.4	-243.2	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fz	STR 3/ 190	-13.1	1.4	-81.8	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mx	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max My	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxy	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Max Myz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fx	STR 3/ 153	-21.9	1.4	-209.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fy	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fz	STR 1/ 48	-12.8	0.0	-611.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mx	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min My	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxy	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0
	Min Myz	STR 1/ 1	-14.5	0.0	-345.0	0.0	0.0	0.0	0.0	0.0	0.0

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Figg Bridge Engineers, Inc.
Combined Limit States Results
File Name: Pier 3 Bearing Reactions.sum

Selected Limit States

SRV 1 - SERVICE I
SRV 3 - SERVICE III

	Max/ Min ID	Combo ID	Fx (kips)	Fy (kips)	Fz (kips)	Mx (ft*kip)	My (ft*kip)	Mz (ft*kip)	Mxy (ft*kip)	Mxz (ft*kip)	Myz (ft*kip)
	Max Fx	SRV 1/ 146	-3.1	0.0	-397.1	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fy	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fz	SRV 1/ 31	-17.9	0.0	-141.7	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mx	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
	Max My	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
Load No.	Max Mz	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
1	Max Mxy	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxz	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
Member	Max Myz	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
Left	Min Fx	SRV 1/ 271	-23.9	0.0	-293.7	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fy	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
Joint	Min Fz	SRV 1/ 467	-9.4	0.0	-571.6	0.0	0.0	0.0	0.0	0.0	0.0
Left	Min Mx	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
	Min My	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mz	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxy	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxz	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
	Min Myz	SRV 1/ 1	-17.3	0.0	-224.7	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fx	SRV 1/ 155	-3.1	0.0	-280.3	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fy	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
	Max Fz	SRV 1/ 13	-17.6	0.0	-126.4	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mx	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
	Max My	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
Load No.	Max Mz	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
2	Max Mxy	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
	Max Mxz	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
Member	Max Myz	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
Right	Min Fx	SRV 1/ 262	-23.9	0.0	-279.9	0.0	0.0	0.0	0.0	0.0	0.0
	Min Fy	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
Joint	Min Fz	SRV 1/ 484	-9.1	0.0	-534.3	0.0	0.0	0.0	0.0	0.0	0.0
Right	Min Mx	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
	Min My	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mz	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxy	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
	Min Mxz	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0
	Min Myz	SRV 1/ 1	-17.3	0.0	-198.3	0.0	0.0	0.0	0.0	0.0	0.0

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DISPLACEMENTS AND ROTATIONS @ BEARINGS
PIER 3 (NORTH END)

	Bearing	Translation X (in)	Translation Y (in)	Translation Z (in)	Rotation X (rad)	Rotation Y (rad)	Rotation Z (rad)
DC_EOC	Left	0.0477	-0.0122	-0.1563	0.0000	-0.0007	0.0000
	Right	0.0467	-0.0122	-0.1572	0.0000	-0.0007	0.0000
CR_EOC	Left	-0.1876	-0.0014	0.0010	0.0000	-0.0006	0.0000
	Right	-0.1878	-0.0014	0.0010	0.0000	-0.0006	0.0000
SH_EOC	Left	0.0959	0.0003	-0.0022	0.0000	0.0001	0.0000
	Right	0.0958	0.0003	-0.0022	0.0000	0.0001	0.0000
PT_EOC	Left	-0.2137	0.0034	0.0305	0.0000	0.0003	0.0000
	Right	-0.2134	0.0034	0.0307	0.0000	0.0003	0.0000
DC_D10K	Left	0.0477	-0.0122	-0.1563	0.0000	-0.0007	0.0000
	Right	0.0467	-0.0122	-0.1572	0.0000	-0.0007	0.0000
CR_D10K	Left	-0.2823	-0.0023	0.0008	0.0000	-0.0010	0.0000
	Right	-0.2827	-0.0023	0.0008	0.0000	-0.0010	0.0000
SH_D10K	Left	-0.2174	-0.0037	-0.0429	0.0000	-0.0006	0.0000
	Right	-0.2178	-0.0037	-0.0431	0.0000	-0.0006	0.0000
PT_D10K	Left	-0.2081	0.0035	0.0327	0.0000	0.0003	0.0000
	Right	-0.2078	0.0035	0.0329	0.0000	0.0003	0.0000
DW	Left	-0.0074	-0.0005	-0.0026	0.0000	0.0001	0.0000
	Right	-0.0074	-0.0005	-0.0026	0.0000	0.0001	0.0000
LL DECK_FULL	Left	-0.0269	-0.0017	-0.0095	0.0000	0.0002	0.0000
	Right	-0.0271	-0.0017	-0.0095	0.0000	0.0002	0.0000
LL DECK_MAIN	Left	-0.0434	-0.0005	0.0197	0.0000	0.0002	0.0000
	Right	-0.0435	-0.0005	0.0198	0.0000	0.0002	0.0000
LL DECK_BACK	Left	0.0165	-0.0012	-0.0292	0.0000	0.0000	0.0000
	Right	0.0163	-0.0012	-0.0293	0.0000	0.0000	0.0000
LL ROOF_FULL	Left	-0.0025	-0.0001	0.0000	0.0000	0.0000	0.0000
	Right	-0.0025	-0.0001	0.0000	0.0000	0.0000	0.0000
LL ROOF_MAIN	Left	-0.0046	-0.0001	0.0024	0.0000	0.0000	0.0000
	Right	-0.0046	-0.0001	0.0024	0.0000	0.0000	0.0000
LL ROOF_BACK	Left	0.0021	-0.0001	-0.0024	0.0000	0.0000	0.0000
	Right	0.0021	-0.0001	-0.0024	0.0000	0.0000	0.0000
LL OFFSET_FULL	Left	-0.0126	0.0103	-0.0106	-0.0001	0.0001	0.0000
	Right	-0.0144	0.0103	0.0012	-0.0001	0.0001	0.0000
LL OFFSET_MAIN	Left	-0.0209	0.0076	0.0107	0.0000	0.0001	0.0000
	Right	-0.0225	0.0076	0.0090	0.0000	0.0001	0.0000
LL OFFSET_BACK	Left	0.0083	0.0027	-0.0213	-0.0001	0.0000	0.0000
	Right	0.0081	0.0027	-0.0078	-0.0001	0.0000	0.0000
WS O DEG	Left						
	Right						
WS 15 DEG	Left						
	Right						
WS 30 DEG	Left						
	Right						
WS 45 DEG	Left						
	Right						
WS 60 DEG	Left						
	Right						

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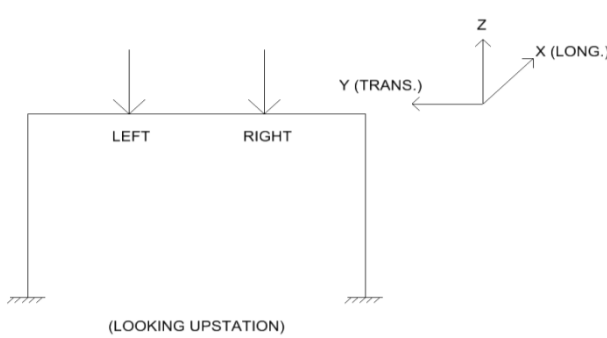
DISPLACEMENTS AND ROTATIONS @ BEARINGS
PIER 3 (NORTH END)

	Bearing	Translation X (in)	Translation Y (in)	Translation Z (in)	Rotation X (rad)	Rotation Y (rad)	Rotation Z (rad)
WS -15 DEG	Left						
	Right						
WS -30 DEG	Left						
	Right						
WS -45 DEG	Left						
	Right						
WS -60 DEG	Left						
	Right						
WS O DEG_70 MPH	Left	0.0032	0.0013	-0.0016	0.0000	0.0000	-0.0001
	Right	-0.0032	0.0013	0.0018	0.0000	0.0000	-0.0001
WS 15 DEG_70 MPH	Left	0.0137	0.0010	-0.0020	0.0000	0.0000	0.0000
	Right	0.0077	0.0010	0.0010	0.0000	0.0000	0.0000
WS 30 DEG_70 MPH	Left	0.0269	0.0003	-0.0026	0.0000	0.0000	0.0000
	Right	0.0213	0.0003	0.0002	0.0000	0.0000	0.0000
WS 45 DEG_70 MPH	Left	0.0373	0.0018	-0.0028	0.0000	0.0000	0.0000
	Right	0.0332	0.0018	-0.0007	0.0000	0.0000	0.0000
WS 60 DEG_70 MPH	Left	0.0436	0.0037	-0.0028	0.0000	0.0000	0.0000
	Right	0.0414	0.0037	-0.0016	0.0000	0.0000	0.0000
WS -15 DEG_70 MPH	Left	-0.0077	0.0010	-0.0008	0.0000	0.0000	0.0000
	Right	-0.0137	0.0010	0.0022	0.0000	0.0000	0.0000
WS -30 DEG_70 MPH	Left	-0.0213	0.0004	0.0000	0.0000	0.0000	0.0000
	Right	-0.0269	0.0004	0.0028	0.0000	0.0000	0.0000
WS -45 DEG_70 MPH	Left	-0.0332	0.0019	0.0009	0.0000	0.0000	0.0000
	Right	-0.0373	0.0019	0.0030	0.0000	0.0000	0.0000
WS -60 DEG_70 MPH	Left	-0.0414	0.0038	0.0016	0.0000	0.0000	0.0000
	Right	-0.0436	0.0038	0.0030	0.0000	0.0000	0.0000
WS+WUP	Left						
	Right						
TU+	Left	0.2701	-0.0023	-0.0261	0.0000	-0.0003	0.0000
	Right	0.2699	-0.0023	-0.0262	0.0000	-0.0003	0.0000
TU-	Left	-0.2701	0.0023	0.0261	0.0000	0.0003	0.0000
	Right	-0.2699	0.0023	0.0262	0.0000	0.0003	0.0000
TU + TEMP. DIFF.	Left	0.2901	-0.0045	-0.0517	0.0000	-0.0006	0.0000
	Right	0.2897	-0.0045	-0.0519	0.0000	-0.0006	0.0000

Notes:
1. Values are unfactored.
2. LL Offset load case considers pedestrian live load only on one side of the bridge deck.
3. The 70 mph wind load cases apply to Service I and Strength V limit states per SDG.



DISPLACEMENTS AND ROTATIONS @ BEARINGS
PIER 3 (NORTH END)

$\Delta_s = 0.65\Delta_T + \Delta_{CR,SH,PT}$		
Load Case	**Bearing**	**Translation X (in)**
$\Delta_{CR,SH,PT}$ **(LT - EOC)**	Left	-0.4024
	Right	-0.4028
Δ_T **(Fall - Rise)**	Left	-0.5402
	Right	-0.5397
Δ_s	Left	-0.7535
	Right	-0.7536

Service I (Static)			
Load Case	**Bearing**	**Translation X (in)**	**Rotation Y (rad)**
$\Delta_{CR,SH,PT}$ **(LT - EOC)**	Left	-0.4024	-0.0011
	Right	-0.4028	-0.0011
$\Delta_{DC} + \Delta_{DW}$	Left	0.0403	-0.0007
	Right	0.0392	-0.0007
$\Delta_{s,st}$ & $\theta_{s,st}$	Left	-0.3620	-0.0017
	Right	-0.3636	-0.0017

Service I (Cyclic) = LL + WS + 1.20 x TU			
Load Case	**Bearing**	**Translation X (in)**	**Rotation Y (rad)**
LL Deck Main, WS 0 deg, +TU	Left	0.2839	-0.0002
	Right	0.2771	-0.0002
LL Deck Main, WS 0 deg, -TU	Left	-0.3643	0.0006
	Right	-0.3705	0.0006
LL Deck Main, WS 0 deg, TU+Temp Diff	Left	0.3079	-0.0005
	Right	0.3009	-0.0005
LL Deck Main, WS 15 deg, +TU	Left	0.2944	-0.0002
	Right	0.2881	-0.0002
LL Deck Main, WS 15 deg, -TU	Left	-0.3538	0.0006
	Right	-0.3596	0.0006
LL Deck Main, WS 15 deg, TU+Temp Diff	Left	0.3184	-0.0005
	Right	0.3119	-0.0005
LL Deck Main, WS 30 deg, +TU	Left	0.3076	-0.0002
	Right	0.3017	-0.0002
LL Deck Main, WS 30 deg, -TU	Left	-0.3406	0.0006
	Right	-0.3460	0.0006
LL Deck Main, WS 30 deg, TU+Temp Diff	Left	0.3316	-0.0005
	Right	0.3254	-0.0005
LL Deck Main, WS 45 deg, +TU	Left	0.3180	-0.0002
	Right	0.3136	-0.0002
LL Deck Main, WS 45 deg, -TU	Left	-0.3302	0.0006
	Right	-0.3341	0.0006
LL Deck Main, WS 45 deg, TU+Temp Diff	Left	0.3420	-0.0005
	Right	0.3373	-0.0005
LL Deck Main, WS 60 deg, +TU	Left	0.3243	-0.0002
	Right	0.3217	-0.0002

DISPLACEMENTS AND ROTATIONS @ BEARINGS
PIER 3 (NORTH END)

LL Deck Main, WS 60 deg, -TU	Left	-0.3239	0.0006
	Right	-0.3259	0.0006
LL Deck Main, WS 60 deg, TU+Temp Diff	Left	0.3483	-0.0006
	Right	0.3455	-0.0006
LL Deck Main, WS -15 deg, +TU	Left	0.2730	-0.0002
	Right	0.2667	-0.0002
LL Deck Main, WS -15 deg, -TU	Left	-0.3752	0.0006
	Right	-0.3810	0.0006
LL Deck Main, WS -15 deg, TU+Temp	Left	0.2970	-0.0005
	Right	0.2904	-0.0005
LL Deck Main, WS -30 deg, +TU	Left	0.2594	-0.0002
	Right	0.2535	-0.0002
LL Deck Main, WS -30 deg, -TU	Left	-0.3888	0.0006
	Right	-0.3942	0.0006
LL Deck Main, WS -30 deg, TU+Temp	Left	0.2834	-0.0005
	Right	0.2772	-0.0005
LL Deck Main, WS -45 deg, +TU	Left	0.2475	-0.0002
	Right	0.2431	-0.0002
LL Deck Main, WS -45 deg, -TU	Left	-0.4007	0.0006
	Right	-0.4046	0.0006
LL Deck Main, WS -45 deg, TU+Temp	Left	0.2715	-0.0005
	Right	0.2669	-0.0005
LL Deck Main, WS -60 deg, +TU	Left	0.2393	-0.0002
	Right	0.2368	-0.0002
LL Deck Main, WS -60 deg, -TU	Left	-0.4089	0.0006
	Right	-0.4109	0.0006
LL Deck Main, WS -60 deg, TU+Temp	Left	0.2634	-0.0005
	Right	0.2606	-0.0005

References: Project Design Criteria
AASHTO LRFD Bridge Design Specifications, 7th Edition, 2014
FDOT SDG, January 2015

AASHTO LRFD 14.7.5 Method B - Design Procedure for Steel-Reinforced Elastomeric Bearings

Pier No. P3

STEP 1: Enter Bearing Loads

	D10K	
P_{st} =	339 kips	Service load corresponding to maximum total compressive load due to static loads = DC + DW + CR + SH + PT
P_{cy} =	233 kips	Service load corresponding to maximum total compressive load due to cyclic loads = LL + WS + TU (includes multiple presence factor and dynamic load allowance)
$P_s = P_{st} + P_{cy}$ =	572 kips	Maximum service compressive load due to total load
P_{LL} =	93 kips	Service load corresponding to maximum total compressive load due to live load (includes multiple presence factor and dynamic load allowance)
P_{DL} =	338 kips	Service load corresponding to maximum total compressive load due to dead load = DC + DW

STEP 2: Enter Bearing Deflections

Δ_s =	0.75 in.	Maximum total shear deformation of the bearing at the service limit state = 0.65 x temp range + CR + SH + PT (modified for substructure stiffness & construction procedures by use of LARSA). *(LRFD 14.7.5.3.2)* 1.20 load factor not applied per SDG 6.5.1.A.
$\Delta_{s,st}$ =	0.36 in.	Maximum total static shear deformation at the service limit state = DC + DW + CR + SH + PT
$\Delta_{s,cy}$ =	0.41 in.	Maximum total cyclic shear deformation at the service limit state = LL + WS + 1.20 x TU
$\theta_{s,st}$ =	0.00670 rad	Maximum static service limit state design rotation angle = DC + DW + CR + SH + PT + 0.005 rad allowance for uncertainties
$\theta_{s,cy}$ =	0.00560 rad	Maximum cyclic service limit state design rotation angle = LL + WS + 1.20 x TU + 0.005 rad allowance for uncertainties

STEP 3: Specify Bearing Plan Dimensions

	L = Length of bearing parallel to long. axis of bridge		W = Width of bearing parallel to trans. axis of bridge	
Try	16 in.	x	40 in.	Bearing Pad Dimensions
	d_{hole} =		0.00 in.	Diameter of Hole in Bearing
$A = (L \times W) - \pi/4 \times d_{hole}^2$ =			640 sq. in.	Bearing Area

STEP 4: Specify Bearing Type & Properties

Shape :	RECTANGULAR		
Durometer =	50	*(from Project Design Criteria)*	
G_{min} =	0.080 ksi	Minimum Shear Modulus *(LRFD 14.7.5.2)*	
G_{max} =	0.175 ksi	Maximum Shear Modulus *(LRFD 14.7.5.2)*	
G =	0.110 ksi	Specified Shear Modulus *(SDG 6.5.1.A)*	OKAY

STEP 5: Design for Compressive Stress - Service Limit State *(FIGG Design Directive No. 24)*

Limit average compressive stress to	1.200 ksi			
$\sigma_s = P_S / A$ =	0.893 ksi	Service compressive stress due to total load	< 1.200ksi	OKAY

NOTE: Bearings designed for stresses above 1.0 ksi are subject to additional testing requirements.

STEP 6: Determine Bearing Height & Number of Elastomer Layers *(LRFD 14.7.5.1)*

Use: h_{ri_int} =	0.625 in	Thickness of interior elastomer layer (typical)	
Maximum $h_{ri\_ext} = 0.70 \times h_{ri\_int}$ =	0.438 in.	Maximum allowable thickness of exterior layers	
Use h_{ri_ext} =	0.375 in.	< 0.438 in.	OKAY
Minimum $N_{int} = (h_{rt} - 2 \times h_{ri\_ext}) / h_{ri\_int}$ =	4	Number of interior layers required	
N_{int} =	4	Number of interior layers used	OKAY

STEP 7: Check Shear Deformation - Service Limit State *(LRFD 14.7.5.3.2)*

Minimum $h_{rt} = 2 \times \Delta_s =$	1.51 in.	Minimum total elastomer thickness		
$h_{rt} = 2 \times h_{ri\_ext} + N_{int} \times h_{ri\_int} =$	3.25 in.	Provided total elastomer thickness	> 1.507 in.	OKAY

STEP 8: Calculate Shape Factor *(LRFD Eq. 14.7.5.1-1)*

$S_{int} = A / [h_{ri\_int} \times (2 \times L + 2 \times W + \pi \times d_{hole})] =$	9.14	Shape Factor of Interior Layer *(LRFD Eq. C14.7.5.1-1)*
$S_{ext} = A / [h_{ri\_ext} \times (2 \times L + 2 \times W + \pi \times d_{hole})] =$	15.24	Shape Factor of Exterior Layer *(LRFD Eq. C14.7.5.1-1)*
$S_i =$	9.14	Conservatively, use the minimum shape factor.

STEP 9: Check Combined Compression, Rotation, and Shear - Service Limit State *(LRFD 14.7.5.3.3)*

$D_a =$	1.40	For rectangular bearings *(LRFD Eq. 14.7.5.3.3-4)*		
$\sigma_{s,st} = P_{st} / A =$	0.530 ksi	Average compressive stress due to total static load		
$\gamma_{a,st} = D_a \times \sigma_{s,st} / (G_{min} \times S_i) =$	1.01	Shear strain caused by axial load (static)	< 3.00	OKAY
$D_r =$	0.50	For rectangular bearings *(LRFD Eq. 14.7.5.3.3-7)*		
$\gamma_{r,st} = D_r \times (L / h_{ri\_int})^2 \times (\theta_{s,st} / N_{int}) =$	0.55	Shear strain caused by rotation (static)		
$\gamma_{s,st} = \Delta_{s,st} / h_{rt} =$	0.11	Shear strain caused by shear deformation (static)		
$\sigma_{s,cy} = P_{cy} / A =$	0.363 ksi	Average compressive stress due to cyclic load		
$\gamma_{a,cy} = D_a \times \sigma_{s,cy} / (G_{min} \times S_i) =$	0.70	Shear strain caused by axial load (cyclic)		
$\gamma_{r,cy} = D_r \times (L / h_{ri\_int})^2 \times (\theta_{s,cy} / N_{int}) =$	0.46	Shear strain caused by rotation (cyclic)		
$\gamma_{s,cy} = \Delta_{s,cy} / h_{rt} =$	0.13	Shear strain caused by shear deformation (cyclic)		
$(\gamma_{a,st} + \gamma_{r,st} + \gamma_{s,st}) + 1.75 \times (\gamma_{a,cy} + \gamma_{r,cy} + \gamma_{s,cy}) =$	3.92	< 5.00	OKAY	

NOTE: When the thickness of an exterior layer is more than 1/2 the thickness of an interior layer, the number of interior layers may be increased by 1/2 for each such exterior layer.

STEP 10: Check Stability of Elastomeric Bearings - Service Limit State (*LRFD 14.7.5.3.4*)

Bearings satisfying LRFD Eq. 14.7.5.3.4-1 shall be considered stable, and no further investigation of stability is required.

$A = 1.92 \times (h_{rt} / L) / \sqrt{(1 + 2.0 \times L / W)} =$	0.291		
$B = 2.67 / [(S_i + 2.0) \times (1 + L / (4 \times W)] =$	0.218		
$2A =$	0.581	> B	CHECK STRESSES

For rectangular bearings not satisfying LRFD Eq. 14.7.5.3.4-1:

Sway = 0 — If bridge is free to translate horizontally, sway = 0. If bridge is fixed against horizontal translation at any point, sway = 1.

$G_{min} \times S_i / (2 \times A - B) =$	2.012 ksi	Bridge free to translate horizontally		
$G_{min} \times S_i / (A - B) =$	10.039 ksi	Bridge fixed against horizontal translation		
$\sigma_s = P_S / A =$	0.893 ksi	Service compressive stress due to total load	< 2.012 ksi	OKAY

STEP 11: Determine Steel Reinforcement Thickness *(LRFD 14.7.5.3.5)*

Service Limit State:

$F_y =$	36 ksi	Yield strength of steel reinforcement	
$\sigma_s = P_S / A =$	0.893 ksi	Service compressive stress due to total load	
Minimum $h_s = MAX(3 \times h_{ri\_int} \times \sigma_s / F_y , 1/16") =$	0.0625 in	Minimum thickness of steel reinforcement for service limit state	
$h_s =$	0.1250 in.	Provided thickness of steel reinforcement	OKAY

Fatigue Limit State:

$\Delta F_{TH} =$	24 ksi	Constant amplitute fatigue threshold for Category A (*LRFD Table 6.6.1.2.3-1)*	
$\sigma_L = P_{LL} / A$	0.145 ksi	Service compressive stress due to live load	
Minimum $h_s = MAX(2 \times h_{ri\_int} \times \sigma_L / \Delta F_{TH} , 1/16") =$	0.0625 in	Minimum thickness of steel reinforcement for fatigue limit state	
$h_s =$	0.1250 in.	Provided thickness of steel reinforcement	OKAY

STEP 12: Check Compressive Deflection - Service Limit State *(LRFD 14.7.5.3.6)*

Instantaneous Live Load Deflection:

δ_{all} =	0.125 in.	Maximum relative live load deflection deflection across joint *(LRFD C14.7.5.3.6)*
$\sigma_{Li} = P_{LL} / A$ =	0.145 ksi	Instantaneous live load compressive stress in an individual elastomer layer
$\varepsilon_{Li} = \sigma_{Li} / (4.8 \times G_{min} \times S_i^2)$ =	0.005	Instantaneous live load compressive strain in *i*th elastomer layer *(LRFD Eq. C14.7.5.3.6-1)*
$\delta_L = \varepsilon_{Li} \times (2 \times h_{ri\_ext} + N_{int} \times h_{ri\_int})$ =	0.015 in.	Instantaneous live load deflection **< 0.125 in.** OKAY

Initial Dead Load Deflection :

$\sigma_{di} = P_{DL} / A$ =	0.528 ksi	Instantaneous dead load compressive stress in an individual elastomer layer
$\varepsilon_{di} = \sigma_{di} / (4.8 \times G_{min} \times S_i^2)$ =	0.016	Instantaneous dead load compressive strain in *i*th elastomer layer *(LRFD Eq. C14.7.5.3.6-1)*
$\delta_d = \varepsilon_{di} \times (2 \times h_{ri\_ext} + N_{int} \times h_{ri\_int})$ =	0.053 in.	Initial dead load deflection

Long-Term Dead Load Deflection:

a_{cr} =	0.25	Creep deflection divided by initial dead load deflection *(LRFD Table 14.7.6.2-1)*
$\delta_{lt} = \delta_d + a_{cr} \times \delta_d$ =	0.067 in.	Long-term dead load deflection

Instantaneous Live Load Deflection + Initial Dead Load Deflection:

$\delta_{all} = 0.09 \times h_{ri\_int}$ =	0.056 in.	Allowable compressive deflection under instantaneous live load and initial dead load *(LRFD 14.7.6.3.3)*
$\delta_{Li} = \varepsilon_{Li} \times h_{ri\_int}$ =	0.003 in.	Compressive deflection of an internal layer under instantaneous live load
$\delta_{di} = \varepsilon_{di} \times h_{ri\_int}$ =	0.010 in.	Compressive deflection of an internal layer under initial dead load
$\delta_{Li} + \delta_{di}$ =	0.013 in.	Compressive deflection under instant. live load and initial dead load **< 0.056 in.** OKAY

STEP 13: Check Anchorage for Bearings without Bonded External Plates - Service Limit State *(LRFD 14.7.5.4)*

$\theta_s = \theta_{s,st} + 1.75 \times \theta_{s,cy}$ =	0.01650 rad	Total static and cyclic design rotation angle (cyclic component is multiplied by 1.75)
$P_a = P_{st} + 1.75 \times P_{cy}$ =	746 kips	Total static and cyclic axial load (cyclic component is multiplied by 1.75)
$\sigma_a = P_a / A$ =	1.166 ksi	Total static and cyclic average axial stress (cyclic component is multiplied by 1.75)
$\varepsilon_a = \sigma_a / (4.8 \times G_{min} \times S_i^2)$ =	0.036	Total static and cyclic average axial strain (cyclic component is multiplied by 1.75)
$3 \times \varepsilon_a / S_i$ =	0.012	
θ_s / N_{int} =	0.004	RESTRAINT SYSTEM NOT REQUIRED

NOTE: When the thickness of an exterior layer is more than 1/2 the thickness of an interior layer, the number of interior layers may be increased by 1/2 for each such exterior layer.

STEP 14: Check Bearing Stress on Concrete - Strength Limit State ***(LRFD 5.7.5)***

f'_c =	5.5 ksi	Compressive strength of substructure
ϕ_b =	0.70	Strength reduction factor for bearing on concrete *(LRFD 5.5.4.2.1)*
A_1 =	640 sq. in.	Area of bearing
A_2 =	640 sq. in.	Assume 90° distribution angle unless greater A2 is needed
$m = MIN[\sqrt{(A_2 / A_1)}, 2]$ =	1.00	
$\phi_b P_n = \phi_b \times 0.85 \times f'_c \times A_1 \times m$ =	2,094 kips	*(LRFD Eq. 5.7.5-2)*
P_u (Strength I) =	841 kips	< 2094 kips OKAY

Summary of Bearing	P3	
Bearing Pad Dimensions =	16 in.	x 40 in.
Use	4	5/8" Internal Layers of Elastomer
	2	3/8" External Layers of Elastomer
	5	1/8" Internal Layers of Steel
Total Bearing Ht =	**3.875 in.**	

Section VI

Expansion Joints

FIGG	Project: FIU	Date: 10-4-16	Page 1 of 1
	Project Number: 2262.03	Designed: EDL	
	Description: EXPANSION JOINT	Checked: MF	

TOTAL MOVEMENT = $1.0(CR+SH_{D10K} - CR+SH_{EOC}) + 1.2(\Delta_{70}TU)$

SOUTH LANDING

JOINT 60

$CR+SH_{EOC} = 0.4152\,in + 0.1019\,in = 0.5171\,in$

$CR+SH_{D10K} = 0.5824\,in + 0.4146\,in = 0.997\,in$

$\Delta_{CR+SH} = 0.997\,in - 0.5171\,in = \underline{0.48\,in}$

$\Delta_{TU} = 0.4448\,in - (-0.4448\,in) = \underline{0.89\,in}$

TOTAL MOVEMENT = $1.0(0.48\,in) + 1.2(0.89\,in) = \underline{\underline{1.5\,in}}$ ✓

NORTH LANDING

JOINT 56

$CR+SH_{EOC} = -0.2161\,in + (-0.0598\,in) = -0.2759\,in$

$CR+SH_{D10K} = -0.3285\,in + (-0.2471\,in) = -0.5756\,in$

$\Delta_{CR+SH} = -0.5756\,in - (-0.2759\,in) = \underline{-0.30\,in}$

$\Delta_{TU} = -0.2586\,in - 0.2586\,in = \underline{-0.52\,in}$

TOTAL MOVEMENT = $1.0(0.30\,in) + 1.2(0.52\,in) = \underline{\underline{0.9\,in}}$ ✓

Result Cases Summary

EOC: EOC: Other PT Losses
Solved: 9/29/2016

Load Class: Prestress Loss(Shrinkage, Elastic Shortening, Creep)

D10K: D10K: Other PT Losses
Solved: 9/29/2016

Load Class: Prestress Loss(Shrinkage, Elastic Shortening, Creep)

Load Cases: TU-
Solved: 9/29/2016

Load Class: None

Load Cases: TU+
Solved: 9/29/2016

Load Class: None

RESULT : Joint Displacements (Creep)

Joint	Result Case	Translation X (in)	Translation Y (in)	Translation Z (in)	Rotation X (rad)	Rotation Y (rad)	Rotation Z (rad)
56	EOC: Other PT Losses	-0.2161	-0.0015	0.0069	0.0000	-0.0003	0.0000
60	EOC: Other PT Losses	0.4152	-0.0014	0.0408	0.0000	0.0019	0.0000

RESULT : Joint Displacements (Shrinkage)

Joint	Result Case	Translation X (in)	Translation Y (in)	Translation Z (in)	Rotation X (rad)	Rotation Y (rad)	Rotation Z (rad)
56	EOC: Other PT Losses	-0.0598	-0.0003	-0.0018	0.0000	-0.0001	0.0000
60	EOC: Other PT Losses	0.1019	0.0004	0.0002	0.0000	0.0001	0.0000

RESULT : Joint Displacements (Creep)

Joint	Result Case	Translation X (in)	Translation Y (in)	Translation Z (in)	Rotation X (rad)	Rotation Y (rad)	Rotation Z (rad)
56	D10K: Other PT Losses	-0.3285	-0.0024	0.0105	0.0000	-0.0005	0.0000
60	D10K: Other PT Losses	0.5824	-0.0020	0.0579	0.0000	0.0027	0.0000

RESULT : Joint Displacements (Shrinkage)

Joint	Result Case	Translation X (in)	Translation Y (in)	Translation Z (in)	Rotation X (rad)	Rotation Y (rad)	Rotation Z (rad)
56	D10K: Other PT Losses	-0.2471	-0.0038	-0.0358	0.0000	-0.0006	0.0000
60	D10K: Other PT Losses	0.4146	0.0049	-0.0180	0.0000	0.0004	0.0000

RESULT : Joint Displacements

Joint	Result Case	Translation X (in)	Translation Y (in)	Translation Z (in)	Rotation X (rad)	Rotation Y (rad)	Rotation Z (rad)
56	TU-	-0.2586	0.0023	0.0224	0.0000	0.0003	0.0000
60	TU-	0.4448	-0.0031	0.0087	0.0000	-0.0002	0.0000

RESULT : Joint Displacements

Joint	Result Case	Translation X (in)	Translation Y (in)	Translation Z (in)	Rotation X (rad)	Rotation Y (rad)	Rotation Z (rad)
56	TU+	0.2586	-0.0023	-0.0224	0.0000	-0.0003	0.0000
60	TU+	-0.4448	0.0031	-0.0087	0.0000	0.0002	0.0000

FIGG

Section VII

Missile Guard Fence & Railing

DESIGN SYNOPSIS

Design calculations are for 96" fence.

Since 42" fence uses same posts and horizontal members for aesthetic continuity, the 96" fence design and details can be used by inspection.

DESIGN CHECKS

Post Flexure:	OK
Post Shear:	OK
Base Plate Flexure:	OK
Base Plate Weld:	OK
Base Plate Bolt Tension:	OK
Base Plate Bolt Prying Action:	OK
Anchor Bolt Pullout:	OK
Curb Rebar:	OK
Horiz. Member Flexure:	OK
Horiz. Member Deflection:	OK

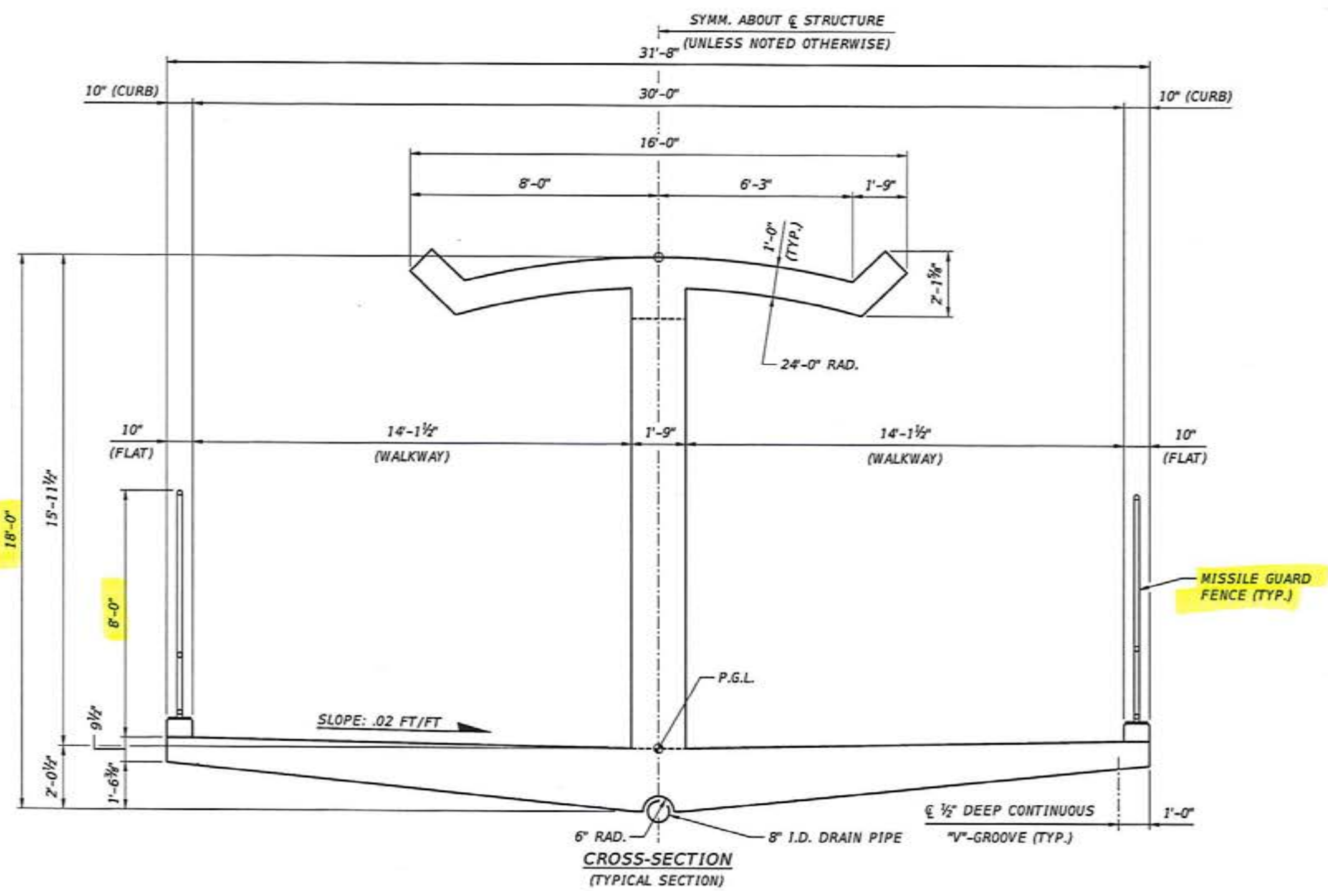
MEMBER DESIGN SUMMARY

Posts:	HSS 4 x 4 x 5/16
Horizontals:	HSS 3 x 3 x 1/8"
Mesh Frame:	L 1 ½" x 1 ½" x 3/16"
Diagonals:	Flat 3/16" x 1"
Mesh:	4 mesh, #9 Gage
Clips (tags):	HSS 2" x 2" x ¼"
Base Plate:	PL 8" x 10 x 7/8"
Anchor Bolts:	4 – 5/8" Φ
Curb Rebar:	#4 @ 12" (min. avg. sp.)

CONNECTION DESIGN SUMMARY

- Weld posts to base plates with ¼" weld
- Weld horizontals to posts with 1/8" weld

90% SUBMITTAL - NOT FOR CONSTRUCTION - JULY 2016



CROSS-SECTION
(TYPICAL SECTION)

NOTES:

1. DRAIN PIPE IS SUPPORTED EVERY 10'-0".
2. FOR MISSILE GUARD FENCE DETAILS, SEE MISSILE GUARD DETAILS (1 OF 2) AND (2 OF 2) DRAWINGS.

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

ENGINEER OF RECORD:
FIGG
424 North Calhoun Street
Tallahassee, Florida 32301
FLORIDA CERTIFICATE OF AUTHORIZATION NO. 5818
W. DENNEY PATE, P.E. - P.E. NO. 34332

DRAWN BY: DCB
CHECKED BY: MF
DESIGNED BY: EDL
CHECKED BY: MF

FIU FLORIDA INTERNATIONAL UNIVERSITY

ROAD NO.	COUNTY	PROJECT ID
	MIAMI-DADE	434688-1-58-01

SHEET TITLE: TYPICAL CROSS-SECTION

PROJECT NAME: UNIVERSITYCITY PROSPERITY PROJECT

SHEET NO. B-5

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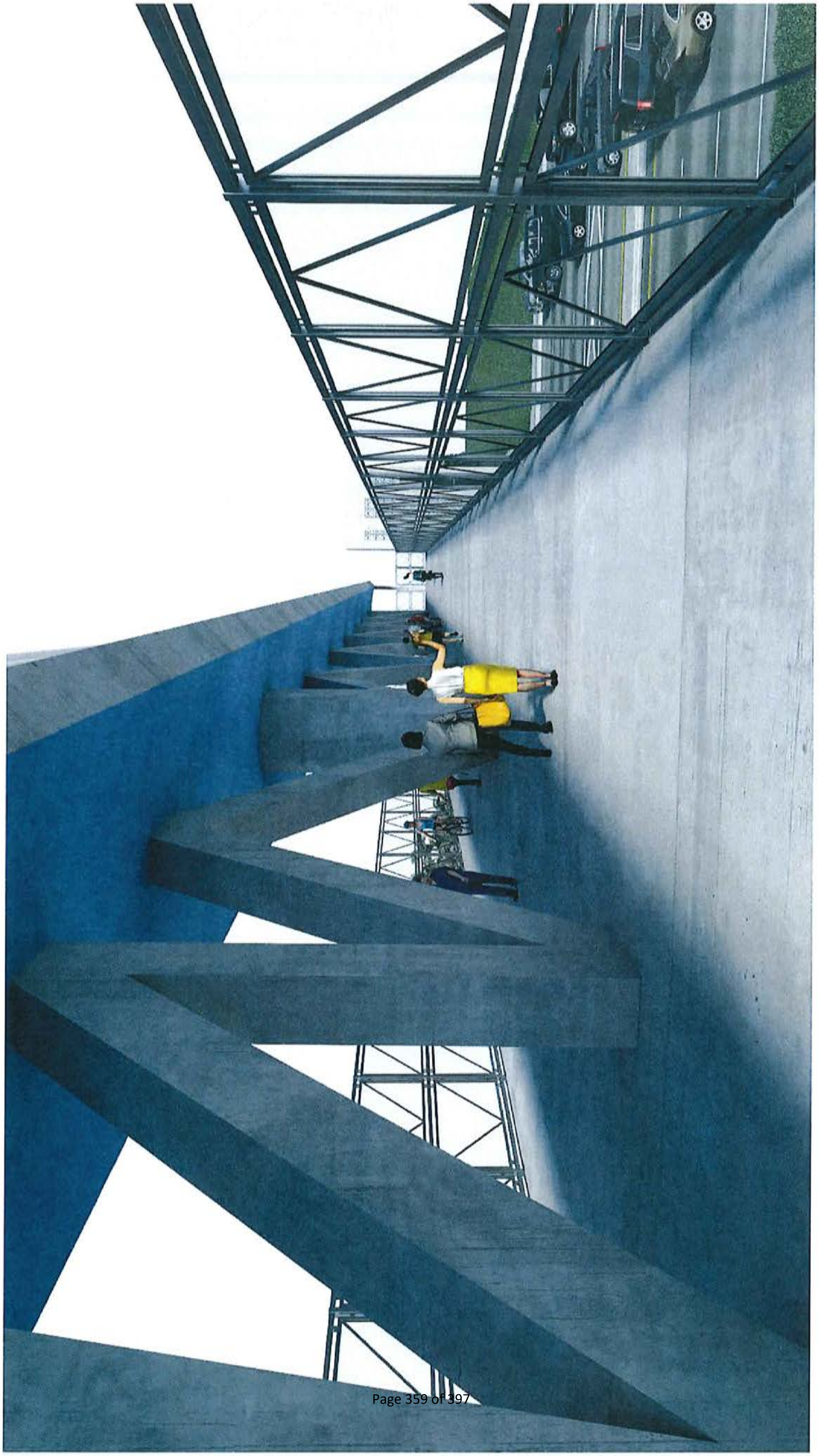


6.8.2 Geometry (Rev. 01/15)

A. The standard height of pedestrian and bicycle railings is 42 inches. Utilize special height bicycle railings only where specifically called for in ***PPM*** Volume 1, Section 8.8.

B. For pedestrian railings without curbs or parapets that are installed on bridges over traffic, sidewalks, trails and waterways, the lowermost clear opening shall reject the passage of a 2 inch diameter sphere. For pedestrian railings without curbs or parapets that are installed on all other bridges and in other locations, the lowermost clear opening shall reject the passage of a 4 inch diameter sphere.

C. In addition to the ***LRFD*** clear opening requirements, for pedestrian railing installations subject to Florida Building Code provisions or other applicable Department owned installations as defined below, a 4 inch diameter sphere shall not pass through openings below a 36 inch height except as specified in the preceding paragraph for the lowermost opening. However, providing adequate sight distance always takes priority over providing smaller opening sizes that meet the 4 inch diameter sphere requirement. Examples of applicable locations include but are not limited to the following:

   1. Highway rest areas and travel information centers
   2. Parking garages
   3. Bridges and their approaches along shared-use paths
   4. View points on bridges where seating is provided
   5. Fishing piers or bridges where fishing is permitted along the sidewalk
   6. Adjacent to other public gathering areas with amenities (e.g. seating, interpretive displays, drinking fountains, etc.)

Commentary: Pedestrian railings on bridges and other structures adjacent to sidewalks having standard widths generally do not have to meet the 4 inch sphere requirement.

6.8.3 Design Live Loads

A. Top and Bottom Rails, Posts and Base Plates: per ***LRFD*** [13.8]

B. Handrails: per Florida Building Code

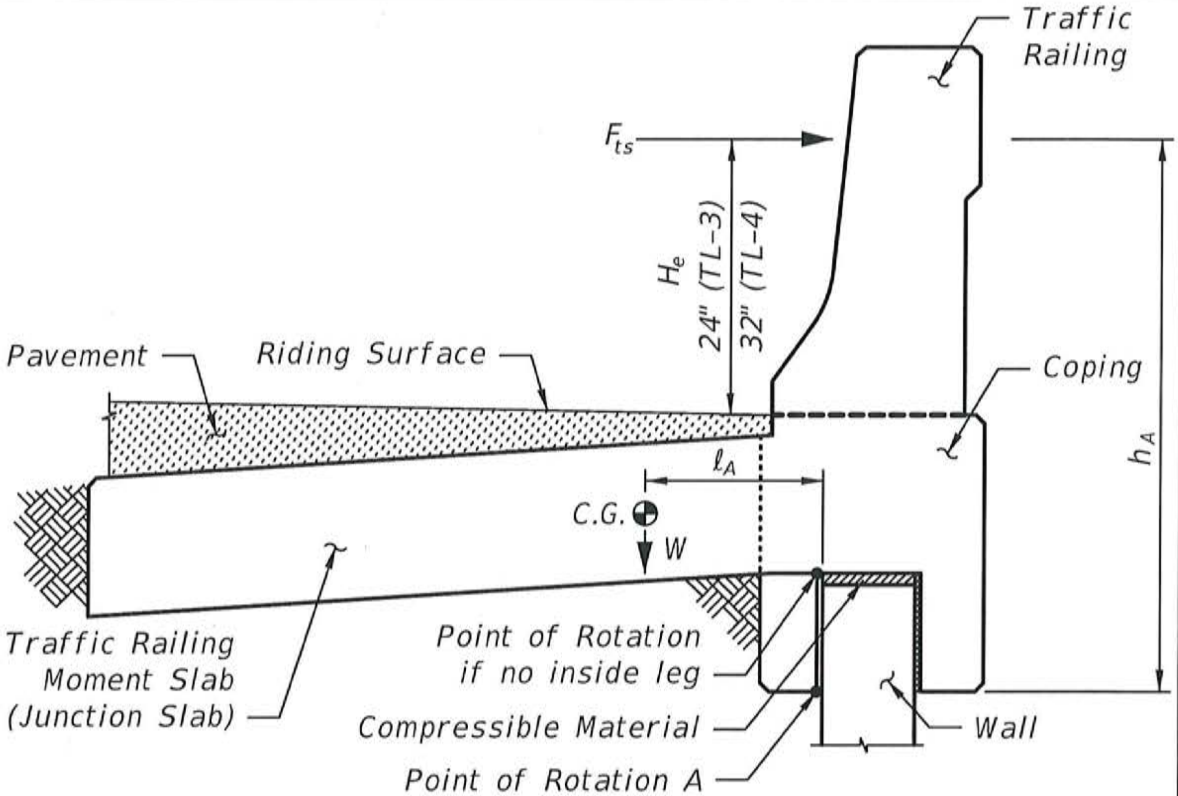
C. Pickets and Infill areas: Concentrated 200 lb. load applied transversely over an area of 1.0 square foot.

Commentary: The use of this design load for pickets and infill areas is intended to result in a more vandal resistant design.

6.8.4 Deflection

Total combined deflection of the pedestrian railing system including the resilient or neoprene pads, due to the top rail design live loads, shall not exceed 1.5 inches when measured at midspan of the top rail.

Figure 6.7.9-1 Traffic Railing-Moment Slab System (Sliding and Overturning)



Traffic Railing - Moment Slab System
(Sliding and Overturning)

6.8 PEDESTRIAN AND BICYCLE RAILINGS [13.8 AND 13.9]

6.8.1 General

A. Design pedestrian and bicycle railings according to ***LRFD*** and this section.

B. Design ADA compliant handrails according to the ***ADA Standards for Transportation Facilities***, Section 505 (Handrails), the Florida Building Code and this section.

C. Design for a 75 year Design Life.

D. See ***PPM*** Volume 1, Chapter 8 for additional information.

Table 3.4.1-1—Load Combinations and Load Factors

Load Combination Limit State	*DC* *DD* *DW* *EH* *EV* *ES* *EL* *PS* *CR* *SH*	*LL* *IM* *CE* *BR* *PL* *LS*	*WA*	*WS*	*WL*	*FR*	*TU*	*TG*	*SE*	Use One of These at a Time				
										EQ	*BL*	*IC*	*CT*	*CV*
Strength I (unless noted)	γ_p	1.75	1.00	—	—	1.00	0.50/1.20	γ_{TG}	γ_{SE}	—	—	—	—	—
Strength II	γ_p	1.35	1.00	—	—	1.00	0.50/1.20	γ_{TG}	γ_{SE}	—	—	—	—	—
Strength III	γ_p	—	1.00	1.40	—	1.00	0.50/1.20	γ_{TG}	γ_{SE}	—	—	—	—	—
Strength IV	γ_p	—	1.00	—	—	1.00	0.50/1.20	—	—	—	—	—	—	—
Strength V	γ_p	1.35	1.00	0.40	1.0	1.00	0.50/1.20	γ_{TG}	γ_{SE}	—	—	—	—	—
Extreme Event I	γ_p	γ_{EQ}	1.00	—	—	1.00	—	—	—	1.00	—	—	—	—
Extreme Event II	γ_p	0.50	1.00	—	—	1.00	—	—	—	—	1.00	1.00	1.00	1.00
Service I	1.00	1.00	1.00	0.30	1.0	1.00	1.00/1.20	γ_{TG}	γ_{SE}	—	—	—	—	—
Service II	1.00	1.30	1.00	—	—	1.00	1.00/1.20	—	—	—	—	—	—	—
Service III	1.00	0.80	1.00	—	—	1.00	1.00/1.20	γ_{TG}	γ_{SE}	—	—	—	—	—
Service IV	1.00	—	1.00	0.70	—	1.00	1.00/1.20	—	1.0	—	—	—	—	—
Fatigue I—*LL*, *IM* & *CE* only	—	1.50	—	—	—	—	—	—	—	—	—	—	—	—
Fatigue II—*LL*, *IM* & *CE* only	—	0.75	—	—	—	—	—	—	—	—	—	—	—	—

Table 3.4.1-2—Load Factors for Permanent Loads, γ_p

Type of Load, Foundation Type, and Method Used to Calculate Downdrag		Load Factor Maximum	Load Factor Minimum
DC: Component and Attachments		1.25	0.90
DC: Strength IV only		1.50	0.90
DD: Downdrag	Piles, α Tomlinson Method	1.4	0.25
	Piles, λ Method	1.05	0.30
	Drilled shafts, O'Neill and Reese (1999) Method	1.25	0.35
DW: Wearing Surfaces and Utilities		1.50	0.65
EH: Horizontal Earth Pressure			
• Active		1.50	0.90
• At-Rest		1.35	0.90
• *AEP* for anchored walls		1.35	N/A
EL: Locked-in Construction Stresses		1.00	1.00
EV: Vertical Earth Pressure			
• Overall Stability		1.00	N/A
• Retaining Walls and Abutments		1.35	1.00
• Rigid Buried Structure		1.30	0.90
• Rigid Frames		1.35	0.90
• Flexible Buried Structures			
o Metal Box Culverts, Structural Plate Culverts with Deep Corrugations, and Fiberglass Culverts		1.5	0.9
o Thermoplastic Culverts		1.3	0.9
o All others		1.95	0.9
ES: Earth Surcharge		1.50	0.75

Table 3.4.1-3—Load Factors for Permanent Loads Due to Superimposed Deformations, γ_p

Bridge Component	*PS*	*CR, SH*
Superstructures—Segmental Concrete Substructures supporting Segmental Superstructures (see 3.12.4, 3.12.5)	1.0	See γ_P for *DC*, Table 3.4.1-2
Concrete Superstructures—non-segmental	1.0	1.0
Substructures supporting non-segmental Superstructures		
• using I_g	0.5	0.5
• using $I_{effective}$	1.0	1.0
Steel Substructures	1.0	1.0

6.5.4.2—Resistance Factors

Resistance factors, ϕ, for the strength limit state shall be taken as follows:

- For flexure $\phi_f = 1.00$
- For shear $\phi_v = 1.00$
- For axial compression, steel only $\phi_c = 0.95$
- For axial compression, composite $\phi_c = 0.90$
- For tension, fracture in net section $\phi_u = 0.80$
- For tension, yielding in gross section $\phi_y = 0.95$
- For bearing on pins in reamed, drilled or bored holes and on milled surfaces $\phi_b = 1.00$
- For bolts bearing on material $\phi_{bb} = 0.80$
- For shear connectors $\phi_{sc} = 0.85$
- For A 325 and A 490 bolts in tension $\phi_t = 0.80$
- For A 307 bolts in tension $\phi_t = 0.80$
- For F 1554 bolts in tension $\phi_t = 0.80$
- For A 307 bolts in shear $\phi_s = 0.75$
- For F 1554 bolts in shear $\phi_s = 0.75$
- For A 325 and A 490 bolts in shear $\phi_s = 0.80$
- For block shear $\phi_{bs} = 0.80$
- For shear, rupture in connection element $\phi_{vu} = 0.80$
- For truss gusset plate compression $\phi_{cg} = 0.75$
- For truss gusset plate chord splices $\phi_{cs} = 0.65$
- For truss gusset plate shear yielding $\phi_{vy} = 0.80$
- For web crippling $\phi_w = 0.80$
- For weld metal in complete penetration welds:
    - o shear on effective area $\phi_{e1} = 0.85$
    - o tension or compression normal to effective area same as base metal
    - o tension or compression parallel to axis of the weldsame as base metal
- For weld metal in partial penetration welds:
    - o shear parallel to axis of weld $\phi_{e2} = 0.80$
    - o tension or compression parallel to axis of weldsame as base metal
    - o compression normal to the effective areasame as base metal
    - o tension normal to the effective area $\phi_{e1} = 0.80$
- For weld metal in fillet welds:
    - o tension or compression parallel to axis of the weldsame as base metal
    - o shear in throat of weld metal $\phi_{e2} = 0.80$
- For resistance during pile driving $\phi = 1.00$

C6.5.4.2

Base metal ϕ as appropriate for resistance under consideration.

The resistance factors for truss gusset plates were developed and calibrated to a target reliability index of 4.5 for the Strength I load combination at a dead-to-live ratio, DL/LL, of 6.0. More liberal ϕ factors could be justified at a DL/LL less than 6.0.

The maximum end distance shall be the maximum edge distance as specified in Article 6.13.2.6.6.

6.13.2.6.6—Edge Distances

The minimum edge distance shall be as specified in Table 6.13.2.6.6-1.

The maximum edge distance shall not be more than eight times the thickness of the thinnest outside plate or 5.0 in.

$8(3/4) = 6''$
$5''$ ⇐ GOVERNS

Table 6.13.2.6.6-1—Minimum Edge Distances

Bolt Diameter	Sheared Edges	Rolled Edges of Plates or Shapes, or Gas Cut Edges
in.	in.	in.
5/8	1-1/8	7/8
3/4	1-1/4	1
7/8	1-1/2	1-1/8
1	1-3/4	1-1/4
1-1/8	2	1-1/2
1-1/4	2-1/4	1-5/8
1-3/8	2-3/8	1-3/4

6.13.2.7—Shear Resistance

The nominal shear resistance of a high-strength bolt (ASTM A325 or ASTM A490) or an ASTM A307 bolt (Grade A or B) at the strength limit state in joints whose length between extreme fasteners measured parallel to the line of action of the force is less than 50.0 in. shall be taken as:

- Where threads are excluded from the shear plane:

$$R_n = 0.48 A_b F_{ub} N_s \quad (6.13.2.7\text{-}1)$$

- Where threads are included in the shear plane:

$$R_n = 0.38 A_b F_{ub} N_s \quad (6.13.2.7\text{-}2)$$

where:

A_b = area of the bolt corresponding to the nominal diameter (in.^{2})

F_{ub} = specified minimum tensile strength of the bolt specified in Article 6.4.3 (ksi)

N_s = number of shear planes per bolt

C6.13.2.7

The nominal resistance in shear is based upon the observation that the shear strength of a single high-strength bolt is about 0.60 times the tensile strength of that bolt (Kulak et al., 1987). However, in shear connections with more than two bolts in the line of force, deformation of the connected material causes nonuniform bolt shear force distribution so that the strength of the connection in terms of the average bolt strength decreases as the joint length increases. Rather than provide a function that reflects this decrease in average fastener strength with joint length, a single reduction factor of 0.80 was applied to the 0.60 multiplier. This accommodates bolts in joints up to 50.0 in. in length without seriously affecting the economy of very short joints. The nominal shear resistance of bolts in joints longer than 50.0 in. must be further reduced by an additional 20 percent. Studies have shown that the allowable stress factor of safety against shear failure ranges from 3.3 for compact, i.e., short, joints to approximately 2.0 for joints with an overall length in excess of 50.0 in. It is of interest to note that the longest and often the most important joints had the lowest factor, indicating that a factor of safety of 2.0 has proven satisfactory in service (Kulak et al., 1987). For flange splices, the 50.0-in. length is to be measured between the extreme bolts on only one side of the connection.

6.13.3.4—Size of Fillet Welds

The size of a fillet weld that may be assumed in the design of a connection shall be such that the forces due to the factored loadings do not exceed the factored resistance of the connection specified in Article 6.13.3.2.

The maximum size of fillet weld that may be used along edges of connected parts shall be taken as:

- For material less than 0.25 in. thick: the thickness of the material, and
- For material 0.25 in. or more in thickness: 0.0625 in. less than the thickness of the material, unless the weld is designated on the contract documents to be built out to obtain full throat thickness.

The minimum size of fillet weld should be taken as specified in Table 6.13.3.4-1. The weld size need not exceed the thickness of the thinner part joined. Smaller fillet welds may be approved by the Engineer based upon applied stress and the use of the appropriate preheat.

Table 6.13.3.4-1—Minimum Size of Fillet Welds

Base Metal Thickness of Thicker Part Joined (T)	Minimum Size of Fillet Weld
in.	in.
$T \leq 3/4$	1/4
$3/4 < T$	5/16

C6.13.3.4

	MIN	MAX
1/4" HSS	1/4"	3/16"
3/4" PL	1/4"	11/16"

The requirements for minimum size of fillet welds are based upon the quench effect of thick material on small welds, not on strength considerations. Very rapid cooling of weld metal may result in a loss of ductility. Further, the restraint to weld metal shrinkage provided by thick material may result in weld cracking. A 0.3125-in. fillet weld is the largest that can be deposited in a single pass by manual process, but minimum preheat and interpass temperatures are to be provided.

6.13.3.5—Minimum Effective Length of Fillet Welds

The minimum effective length of a fillet weld shall be four times its size and in no case less than 1.5 in.

6.13.3.6—Fillet Weld End Returns

Fillet welds that resist a tensile force not parallel to the axis of the weld or that are not proportioned to withstand repeated stress shall not terminate at corners of parts or members. Where such returns can be made in the same plane, they shall be returned continuously, full size, around the corner, for a length equal to twice the weld size. End returns shall be indicated in the contract documents.

Fillet welds deposited on the opposite sides of a common plane of contact between two parts shall be interrupted at a corner common to both welds.

C6.13.3.6

End returns should not be provided around transverse stiffeners.

6.13.3.7—Seal Welds

Seal welds should be a continuous weld combining the functions of sealing and strength, changing section only

13.7.3.1.2—New Systems

New railing systems may be used, provided that acceptable performance is demonstrated through full-scale crash tests.

The crash test specimen for a railing system may be designed to resist the applied loads in accordance with Appendix A13.

Provision shall be made to transfer loads from the railing system to the deck. Railing loads may be taken from Appendix A13.

Unless a lesser thickness can be proven satisfactory during the crash testing procedure, the minimum edge thickness for concrete deck overhangs shall be taken as:

- For concrete deck overhangs supporting a deck-mounted post system: 8.0 in.
- For a side-mounted post system: 12.0 in.
- For concrete deck overhangs supporting concrete parapets or barriers: 8.0 in.

C13.7.3.1.2

Preliminary design for bridge decks should comply with Article A13.1.2. A determination of the adequacy of deck reinforcement for the distribution of post anchorage loads to the deck should be made during the rail testing program. If the rail testing program satisfactorily models the bridge deck, damage to the deck edge can be assessed at this time.

In adequately designed bridge deck overhangs, the major crash-related damage presently occurs in short sections of slab areas where the barrier is hit.

13.7.3.2—Height of Traffic Parapet or Railing

Traffic railings shall be at least 27.0 in. for TL-3, 32.0 in. for TL-4, 42.0 in. for TL-5, and 90.0 in. in height for TL-6.

The bottom 3.0-in. lip of the safety shape shall not be increased for future overlay considerations.

The minimum height for a concrete parapet with a vertical face shall be 27.0 in. The height of other combined concrete and metal rails shall not be less than 27.0 in. and shall be determined to be satisfactory through crash testing for the desired test level.

The minimum height of the pedestrian or bicycle railing should be measured above the surface of the sidewalk or bikeway.

The minimum geometric requirements for combination railings beyond those required to meet crash test requirements shall be taken as specified in Articles 13.8, 13.9, and 13.10.

C13.7.3.2

These heights have been determined as satisfactory through crash tests performed in accordance with NCHRP Report 350 and experience.

For future deck overlays, an encroachment of 2.0 in., leaving a 1.0-in. lip, has been satisfactorily tested for safety shapes.

13.8—PEDESTRIAN RAILING

13.8.1—Geometry

The minimum height of a pedestrian railing shall be 42.0 in. measured from the top of the walkway.

A pedestrian rail may be composed of horizontal and/or vertical elements. The clear opening between elements shall be such that a 6.0 in. diameter sphere shall not pass through.

When both horizontal and vertical elements are used, the 6.0 in. clear opening shall apply to the lower 27.0 in. of the railing, and the spacing in the upper portion shall be such that a 8.0-in. diameter sphere shall not pass through. A safety toe rail or curb should be provided. Rails should

C13.8.1

project beyond the face of posts and/or pickets as shown in Figure A13.1.1-2.

The rail spacing requirements given above should not apply to chain link or metal fabric fence support rails and posts. Mesh size in chain link or metal fabric fence should have openings no larger than 2.0 in.

The size of openings should be capable of retaining an average size beverage container.

13.8.2—Design Loads

The design live load for pedestrian railings shall be taken as $w = 0.050$ klf, both transversely and vertically, acting simultaneously. In addition, each longitudinal element will be designed for a concentrated load of 0.20 kips, which shall act simultaneously with the above loads at any point and in any direction at the top of the longitudinal element.

The posts of pedestrian railings shall be designed for a concentrated design live load applied transversely at the center of gravity of the upper longitudinal element or, for railings with a total height greater than 5.0 ft, at a point 5.0 ft above the top surface of the sidewalk. The value of the concentrated design live load for posts, P_{LL}, in kips, shall be taken as:

$$P_{LL} = 0.20 + 0.050L \quad (13.8.2\text{-}1)$$

where:

L = post spacing (ft)

The application of loads shall be as indicated in Figure 13.8.2-1, in which the shapes of rail members are illustrative only. Any material or combination of materials specified in Article 13.5 may be used.

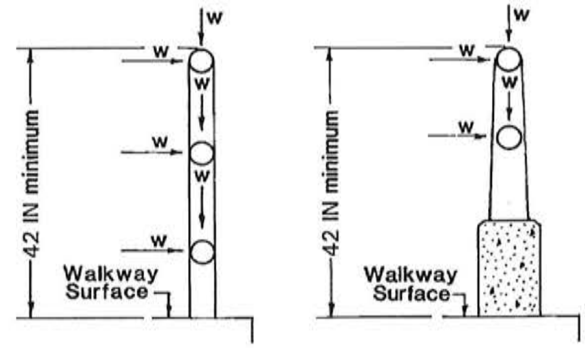


Figure 13.8.2-1—Pedestrian Railing Loads—To be used on the outer edge of a sidewalk when highway traffic is separated from pedestrian traffic by a traffic railing. Railing shape illustrative only.

The design wind load for chain link or metal fabric fence shall be taken as 0.015 ksf acting normal to the entire surface.

C13.8.2

These live loads apply to the railing. The pedestrian live load, specified in Article 3.6.1.6, applies to the sidewalk.

13.9—BICYCLE RAILINGS

13.9.1—General

Bicycle railings shall be used on bridges specifically designed to carry bicycle traffic and on bridges where specific protection of bicyclists is deemed necessary.

13.9.2—Geometry

The height of a bicycle railing shall not be less than 42.0 in., measured from the top of the riding surface.

Bicycle railings shall have rail spacing satisfying the respective provisions of Article 13.8.1.

If deemed necessary, rubrails attached to the rail or fence to prevent snagging should be deep enough to protect a wide range of bicycle handlebar heights.

If screening, fencing, or a solid face is utilized, the number of rails may be reduced.

C13.9.2

Railings, fences or barriers on either side of a shared use path on a structure, or along bicycle lane, shared use path or signed shared roadway located on a highway bridge should be a minimum of 42.0 in. high. The 42.0-in. minimum height is in accordance with the *AASHTO Guide for the Development of Bicycle Facilities*, Third Edition (1999).

On such a bridge or bridge approach where high-speed high-angle impact with a railing, fence or barrier are more likely to occur (such as short radius curves with restricted sight distance or at the end of a long descending grade) or in locations with site-specific safety concerns, a railing, fence or barrier height above the minimum should be considered.

The need for rubrails attached to a rail or fence is controversial among many bicyclists.

13.9.3—Design Live Loads

If the rail height exceeds 54.0 in. above the riding surface, design loads shall be determined by the Designer. The design loads for the lower 54.0 in. of the bicycle railing shall not be less than those specified in Article 13.8.2, except that for railings with total height greater than 54.0 in., the design live load for posts shall be applied at a point 54.0 in. above the riding surface.

The application of loads shall be as indicated in Figure 13.9.3-1. Any material or combination of materials specified in Article 13.5 may be used.

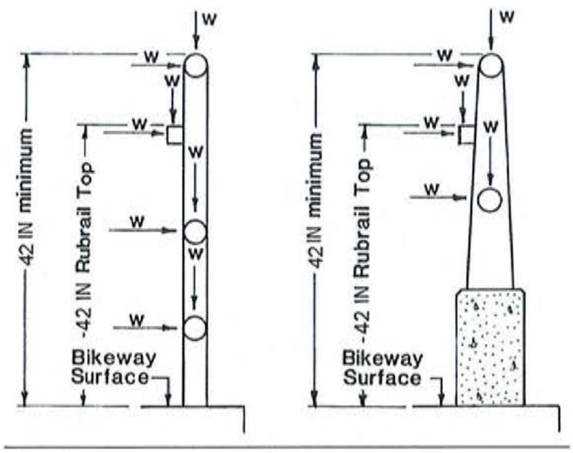


Figure 13.9.3-1—Bicycle Railing Loads—To be used on the outer edge of a bikeway when highway traffic is separated from bicycle traffic by a traffic railing. Railing shape illustrative only.

13.10—COMBINATION RAILINGS

13.10.1—General

The combination railing shall conform to the requirements of either the pedestrian or bicycle railings, as specified in Articles 13.8 and 13.9, whichever is applicable. The traffic railing portion of the combination railing shall conform to Article 13.7.

13.10.2—Geometry

The geometric provisions of Articles 13.7, 13.8, and 13.9 shall apply to their respective portions of a combination railing.

13.10.3—Design Live Loads

Design loads, specified in Articles 13.8 and 13.9, shall not be applied simultaneously with the vehicular impact loads.

13.11—CURBS AND SIDEWALKS

13.11.1—General

Horizontal measurements of roadway width shall be taken from the bottom of the face of the curb. A sidewalk curb located on the highway traffic side of a bridge railing shall be considered an integral part of the railing and shall be subject to the crash test requirements specified in Article 13.7.

13.11.2—Sidewalks

When curb and gutter sections with sidewalks are used on roadway approaches, the curb height for raised sidewalks on the bridge should be no more than 8.0 in. If a barrier curb is required, the curb height should not be less than 6.0 in. If the height of the curb on the bridge differs from that off the bridge, it should be uniformly transitioned over a distance greater than or equal to 20 times the change in height.

C13.11.2

Raised sidewalks on bridges are not usually provided where the approach roadway is not curbed for pedestrians or the structure is not planned for pedestrian occupancy.

For recommendations on sidewalk width, see Figure 13.7.1.1-1 and AASHTO's *A Policy on Geometric Design of Highways and Streets*.

During stage construction, the same transition considerations will be given to the provision of ramps from the bridge sidewalk to the approach surface.

13.11.3—End Treatment of Separation Railing

The end treatment of any traffic railing or barrier shall meet the requirements specified in Articles 13.7.1.2 and 13.7.1.3.

13.12—REFERENCES

AASHTO. 2009. *Manual for Assessing Safety Hardware*, MASH-1. American Association of State Highway and Transportation Officials, Washington, DC.

AASHTO. 2011. *A Policy on Geometric Design of Highways and Streets*, Sixh Edition, GDHS-6. American Association of State Highway and Transportation Officials, Washington, DC.

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Alberson, D. C., R. A. Zimmer, and W. L. Menges. 1997. *NCHRP Report 350 Compliance Test 5-12 of the 1.07-m Vertical Wall Bridge Railing*, FHWA/RD-96/199. Federal Highway Administration, U.S. Department of Transportation, Washington, DC.

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Michie, J. D. 1981. *NCHRP Report 230: Recommended Procedures for the Safety Performance Evaluation of Highway Appurtenances*. Transportation Research Board, National Research Council, Washington, DC.

Ross, H. E., D. L. Sicking, R. A. Zimmer, and J. D. Michie. 1993. *NCHRP Report 350: Recommended Procedures for the Safety Performance Evaluation of Highway Features*. Transportation Research Board, National Research Council, Washington, DC.

Table 1-12 (continued)
Square HSS
Dimensions and Properties

HSS4-HSS2

Shape	Design Wall Thickness, t	Nominal Wt.	Area, A	b/t	h/t	I	S	r	Z	Workable Flat	Torsion J	Torsion C	Surface Area
	in.	lb/ft	in.^{2}			in.^{4}	in.^{3}	in.	in.^{3}	in.	in.^{4}	in.^{3}	ft^2/ft
HSS4×4×1/2	0.465	21.63	6.02	5.60	5.60	11.9	5.97	1.41	7.70	—	21.0	11.2	1.20
×3/8	0.349	17.27	4.78	8.46	8.46	10.3	5.13	1.47	6.39	2 5/16	17.5	9.14	1.23
×5/16	0.291	14.83	4.10	10.7	10.7	9.14	4.57	1.49	5.59	2 5/8	15.3	7.91	1.25
×1/4	0.233	12.21	3.37	14.2	14.2	7.80	3.90	1.52	4.69	2 7/8	12.8	6.56	1.27
×3/16	0.174	9.42	2.58	20.0	20.0	6.21	3.10	1.55	3.67	3 3/16	10.0	5.07	1.28
×1/8	0.116	6.46	1.77	31.5	31.5	4.40	2.20	1.58	2.56	3 7/16	6.91	3.49	1.30
HSS3 1/2×3 1/2×3/8	0.349	14.72	4.09	7.03	7.03	6.49	3.71	1.26	4.69	—	11.2	6.77	1.07
×5/16	0.291	12.70	3.52	9.03	9.03	5.84	3.34	1.29	4.14	2 1/8	9.89	5.90	1.08
×1/4	0.233	10.51	2.91	12.0	12.0	5.04	2.88	1.32	3.50	2 3/8	8.35	4.92	1.10
×3/16	0.174	8.15	2.24	17.1	17.1	4.05	2.31	1.35	2.76	2 11/16	6.56	3.83	1.12
×1/8	0.116	5.61	1.54	27.2	27.2	2.90	1.66	1.37	1.93	2 15/16	4.58	2.65	1.13
HSS3×3×3/8	0.349	12.17	3.39	5.60	5.60	3.78	2.52	1.06	3.25	—	6.64	4.74	0.900
×5/16	0.291	10.58	2.94	7.31	7.31	3.45	2.30	1.08	2.90	—	5.94	4.18	0.917
×1/4	0.233	8.81	2.44	9.88	9.88	3.02	2.01	1.11	2.48	—	5.08	3.52	0.933
×3/16	0.174	6.87	1.89	14.2	14.2	2.46	1.64	1.14	1.97	2 3/16	4.03	2.76	0.950
×1/8	0.116	4.75	1.30	22.9	22.9	1.78	1.19	1.17	1.40	2 7/16	2.84	1.92	0.967
HSS2 1/2×2 1/2×5/16	0.291	8.45	2.35	5.59	5.59	1.82	1.46	0.880	1.88	—	3.20	2.74	0.750
×1/4	0.233	7.11	1.97	7.73	7.73	1.63	1.30	0.908	1.63	—	2.79	2.35	0.767
×3/16	0.174	5.59	1.54	11.4	11.4	1.35	1.08	0.937	1.32	—	2.25	1.86	0.784
×1/8	0.116	3.90	1.07	18.6	18.6	0.998	0.799	0.965	0.947	—	1.61	1.31	0.800
HSS2 1/4×2 1/4×1/4	0.233	6.26	1.74	6.66	6.66	1.13	1.01	0.806	1.28	—	1.96	1.85	0.683
×3/16	0.174	4.96	1.37	9.93	9.93	0.953	0.847	0.835	1.04	—	1.60	1.48	0.700
×1/8	0.116	3.48	0.956	16.4	16.4	0.712	0.633	0.863	0.755	—	1.15	1.05	0.717
HSS2×2×1/4	0.233	5.41	1.51	5.58	5.58	0.747	0.747	0.704	0.964	—	1.31	1.41	0.600
×3/16	0.174	4.32	1.19	8.49	8.49	0.641	0.641	0.733	0.797	—	1.09	1.14	0.617
×1/8	0.116	3.05	0.840	14.2	14.2	0.486	0.486	0.761	0.584	—	0.796	0.817	0.633

Note: For compactness criteria, refer to Table 1-12A.
— Indicates flat depth or width is too small to establish a workable flat.

Table 1-12A
Rectangular and Square HSS
Compactness Criteria

Compactness Criteria for Rectangular and Square HSS

Nominal Wall Thickness, in.	Compression: nonslender up to	Flexure: compact up to	Flexure: compact up to	Shear: $C_v = 1.0$ up to
	Flange Width, in.	Flange Width, in.	Web Height, in.	Web Height, in.
5/8	20	18	20	20
1/2	16	14	20	20
3/8	12	10	20	20
5/16	10	9	18	18
1/4	8	7	14	14
3/16	6	5	10	10
1/8	4	3 1/2	7	7

Note: Compactness criteria given for $F_y = 46$ ksi.

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Size	Gauge/Wall	Wt/Ft	Grade	Finish	Size	Gauge/Wall	Wt/Ft	Grade	Finish
2-1/2" contd	1/4 (.250)	7.67	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror	3-1/2"	11 (.120)	5.67	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror
3"	16 (.062)	2.59	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror	3-1/2"	7 (.180)	8.06	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror
3"	14 (.083)	3.29	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror	3-1/2"	1/4 (.250)	10.89	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror
3"	12 (.109)	4.53	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror	4"	14 (.083)	4.36	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror
3"	11 (.120)	4.97	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror	4"	12 (.109)	5.69	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror
3"	7 (.180)	6.90	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror	4"	11 (.120)	6.26	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror
3"	1/4 (.250)	9.35	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror	4"	7 (.180)	9.27	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror
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3-1/2"	16 (.062)	4.92	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror	4"	5/16 (.313)	15.54	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror

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3"	1/4 (.250)	9.35	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror	4"	7 (.180)	9.27	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror
3-1/2"	14 (.083)	3.91	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror	4"	1/4 (.250)	12.68	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror
3-1/2"	16 (.062)	4.92	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror	4"	5/16 (.313)	15.54	304 304L 316L	Mill #4 Polish 240 Grit 320 Grit #8 Mirror

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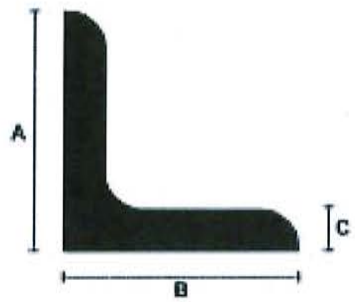
ASTM A36



See Material Characteristics & Specifications on Page 4-6

Ready to Ship! Stock Lengths (+/- 1/4")					
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Also Available Custom Cut to Length					

	Item Size (Inches) A x B x C	Weight per Foot (lbs)	Stock No.
	1/2 x 1/2 x 1/8	.38	A1121218
	3/4 x 3/4 x 1/8	.59	A1343418
	1 x 1 x 1/8	.80	A11118
	1 x 1 x 3/16	1.16	A111316
	1 x 1 x 1/4	1.49	A11114
	1-1/4 x 1-1/4 x 1/8	1.01	A111418
	1-1/4 x 1-1/4 x 3/16	1.48	A1114316
	1-1/4 x 1-1/4 x 1/4	1.92	A111414
	1-1/2 x 1-1/2 x 1/8	1.22	A111218
	1-1/2 x 1-1/2 x 3/16	1.80	A1112316
	1-1/2 x 1-1/2 x 1/4	2.34	A111214
■	1-3/4 x 1-3/4 x 1/8	1.44	A113418
■	1-3/4 x 1-3/4 x 3/16	2.12	A1134316
■	1-3/4 x 1-3/4 x 1/4	2.77	A113414
	2 x 1-1/2 x 1/8	1.44	A1211218
■	2 x 1-1/2 x 3/16	2.12	A12112316
	2 x 1-1/2 x 1/4	2.77	A1211214
	2 x 2 x 1/8	1.65	A12218
	2 x 2 x 3/16	2.44	A122316
	2 x 2 x 1/4	3.19	A12214
	2 x 2 x 3/8	4.70	A12238
■	2-1/2 x 1-1/2 x 3/16	2.44	A1212112316
■	2-1/2 x 1-1/2 x 1/4	3.16	A121211214
■	2-1/2 x 2 x 3/16	2.75	A12122316
■	2-1/2 x 2 x 1/4	3.62	A1212214
■	2-1/2 x 2-1/2 x 3/16	3.07	A1212316
	2-1/2 x 2-1/2 x 1/4	4.1	A121214
■	2-1/2 x 2-1/2 x 3/8	5.9	A121238
	3 x 2 x 3/16	3.07	A232316
	3 x 2 x 1/4	4.1	A23214
■	3 x 2 x 3/8	5.9	A23238
	3 x 3 x 3/16	3.71	A233316
	3 x 3 x 1/4	4.9	A23314
	3 x 3 x 3/8	7.2	A23338
	3 x 3 x 1/2	9.4	A23312
	3-1/2 x 3-1/2 x 1/4	5.8	A231214
	3-1/2 x 3-1/2 x 3/8	8.5	A231238
	4 x 3 x 1/4	5.8	A24314
	4 x 3 x 3/8	8.5	A24338
	4 x 4 x 1/4	6.6	A24414
	4 x 4 x 3/8	9.8	A24438
	4 x 4 x 1/2	12.8	A24412
■	4 x 4 x 3/4	18.5	A24434
	5 x 3 x 1/4	6.6	A25314
■	5 x 3 x 3/8	9.8	A25338
	5 x 3-1/2 x 1/4	7.0	A2531214
■	5 x 3-1/2 x 3/8	10.4	A2531238
	5 x 5 x 3/8	12.3	A25538
■	5 x 5 x 1/2	16.2	A25512
	6 x 4 x 3/8	12.3	A26438
■	6 x 4 x 1/2	16.2	A26412
	6 x 6 x 3/8	14.9	A26638
	6 x 6 x 1/2	19.6	A26612
■	6 x 6 x 3/4	28.7	A26634
■	8 x 4 x 1/2	19.6	A28412
■	8 x 6 x 1/2	23.0	A28612
	8 x 8 x 1/2	26.4	A28812
■	8 x 8 x 3/4	38.9	A28834

Order Online! *Visit MetalsDepot.com or Call 1-859-745-2650 for Current Pricing.*

Hot Rolled Steel Strip Flats

ASTM A569

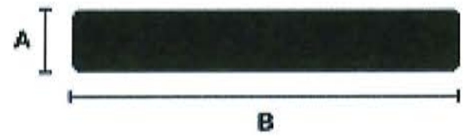
See Material Characteristics & Specifications on Page 4-6

Ready to Ship! Stock Lengths (+/- 1/4")					
2ft	4ft	6ft	8ft	10ft	20ft
Also Available Custom Cut to Length					

Item Size (Inches) A x B	Weight per Foot (lbs)	Stock No.
1/8 x 1/2	.213	F11812
1/8 x 3/4	.319	F11834
1/8 x 1	.425	F1181
1/8 x 1-1/4	.531	F118114
1/8 x 1-1/2	.638	F118112
1/8 x 2	.850	F1182
1/8 x 2-1/2	1.06	F118212
1/8 x 3	1.28	F1183
1/8 x 4	1.70	F1184
1/8 x 5	2.13	F1185
1/8 x 6	2.55	F1186
1/8 x 8	3.40	F1188
3/16 x 1/2	.319	F131612
3/16 x 3/4	.478	F131634
* 3/16 x 1	.638	F13161
3/16 x 1-1/4	.797	F1316114
3/16 x 1-1/2	.956	F1316112
3/16 x 2	1.28	F13162
3/16 x 3	1.91	F13163
3/16 x 4	2.55	F13164
3/16 x 5	3.19	F13165
3/16 x 6	3.83	F13166
3/16 x 8	5.10	F13168
3/16 x 10	6.38	F131610
3/16 x 12	7.65	F1316-12

Hot Rolled Steel Flat Bar

ASTM A36



See Material Characteristics & Specifications on Page 4-6

Ready to Ship! Stock Lengths (+/- 1/4")					
2ft	4ft	6ft	8ft	10ft	20ft
Also Available Custom Cut to Length					

Item Size (Inches) A x B	Weight per Foot (lbs)	Stock No.
1/4 x 1/2	.425	F21412
1/4 x 3/4	.638	F21434
1/4 x 1	.850	F2141
1/4 x 1-1/4	1.06	F214114
1/4 x 1-1/2	1.28	F214112
1/4 x 2	1.70	F2142
1/4 x 2-1/2	2.13	F214212
1/4 x 3	2.55	F2143
1/4 x 3-1/2	2.98	F214312
1/4 x 4	3.40	F2144
1/4 x 5	4.25	F2145
1/4 x 5-1/2	4.68	F214512
1/4 x 6	5.10	F2146
1/4 x 7	5.95	F2147
1/4 x 8	6.80	F2148
1/4 x 9	7.65	F2149
1/4 x 10	8.50	F21410
1/4 x 11	9.35	F21411
1/4 x 12	10.2	F214-12
3/8 x 3/4	.956	F23834
3/8 x 1	1.28	F2381
3/8 x 1-1/2	1.91	F238112
3/8 x 2	2.55	F2382
3/8 x 2-1/2	3.19	F238212
3/8 x 3	3.83	F2383

Any Quantity … Any Size … Delivered Anywhere!

SPACE SCREEN STANDARD SPECIFICATIONS

Clear Opening of Space Inch	Diameter of Rod or Wire Inch	Steel Weight Pounds Per Sq. Ft.	Open Area
4	1.000	13.06	64.0%
4	0.750	7.68	70.9%
4	0.688	6.53	72.8%
4	0.625	5.46	74.8%
4	0.563	4.47	76.9%
4	0.500	3.58	79.0%
4	0.438	2.77	81.3%
4	0.375	2.07	83.6%
4	0.313	1.45	86.0%
4	0.283	1.20	87.2%
4	0.263	1.04	88.0%
4	0.250	0.94	88.6%
3-3/4	1.000	13.77	62.3%
3-3/4	0.750	8.11	69.4%
3-3/4	0.688	6.90	71.4%
3-3/4	0.625	5.77	73.5%
3-3/4	0.563	4.74	75.7%
3-3/4	0.500	3.79	77.9%
3-3/4	0.438	2.94	80.2%
3-3/4	0.375	2.19	82.6%
3-3/4	0.313	1.54	85.2%
3-3/4	0.283	1.27	86.5%
3-3/4	0.263	1.11	87.3%
3-3/4	0.250	1.00	87.9%
3-1/2	1.000	14.57	60.5%
3-1/2	0.750	8.60	67.8%
3-1/2	0.688	7.32	69.9%
3-1/2	0.625	6.13	72.0%
3-1/2	0.563	5.03	74.3%
3-1/2	0.500	4.03	76.6%
3-1/2	0.438	3.13	79.0%
3-1/2	0.375	2.33	81.6%
3-1/2	0.313	1.65	84.3%
3-1/2	0.283	1.36	85.6%
3-1/2	0.263	1.18	86.5%
3-1/2	0.250	1.07	87.1%
3-1/2	0.225	0.87	88.3%
3-1/2	0.207	0.74	89.1%
3-1/4	1.000	15.47	58.5%
3-1/4	0.750	9.16	66.0%
3-1/4	0.688	7.80	68.1%
3-1/4	0.625	6.54	70.3%
3-1/4	0.563	5.37	72.6%
3-1/4	0.500	4.31	75.0%
3-1/4	0.438	3.35	77.6%
3-1/4	0.375	2.50	80.4%
3-1/4	0.313	1.76	83.2%
3-1/4	0.283	1.46	84.6%
3-1/4	0.263	1.26	85.6%
3-1/4	0.250	1.15	86.2%
3-1/4	0.225	0.93	87.5%
3-1/4	0.207	0.79	88.4%
3-1/4	0.192	0.69	89.2%
3	1.000	16.50	56.3%
3	0.750	9.79	64.0%
3	0.688	8.35	66.2%
3	0.625	7.00	68.5%
3	0.563	5.76	70.9%
3	0.500	4.62	73.5%
3	0.438	3.59	76.2%
3	0.375	2.68	79.0%
3	0.313	1.90	82.0%
3	0.283	1.57	83.5%
3	0.263	1.36	84.5%
3	0.250	1.23	85.2%
3	0.225	1.01	86.5%
3	0.207	0.86	87.5%
3	0.192	0.74	88.3%
3	0.177	0.63	89.2%
3	0.162	0.53	90.0%
2-3/4	1.000	17.67	53.7%
2-3/4	0.750	10.52	61.7%
2-3/4	0.688	8.98	64.0%
2-3/4	0.625	7.54	66.4%
2-3/4	0.563	6.20	68.9%
2-3/4	0.500	4.98	71.6%
2-3/4	0.438	3.88	74.4%
2-3/4	0.375	2.90	77.4%
2-3/4	0.313	2.05	80.6%
2-3/4	0.283	1.70	82.2%
2-3/4	0.263	1.48	83.3%
2-3/4	0.250	1.34	84.0%
2-3/4	0.225	1.09	85.4%
2-3/4	0.207	0.93	86.5%
2-3/4	0.192	0.80	87.4%
2-3/4	0.177	0.69	88.3%
2-3/4	0.162	0.58	89.2%
2-3/4	0.148	0.48	90.0%

Clear Opening of Space Inch	Diameter of Rod or Wire Inch	Steel Weight Pounds Per Sq. Ft.	Open Area
2-1/2	1.000	19.02	51.0%
2-1/2	0.750	11.37	59.2%
2-1/2	0.688	9.71	61.5%
2-1/2	0.625	8.16	64.0%
2-1/2	0.563	6.72	66.6%
2-1/2	0.500	5.41	69.4%
2-1/2	0.438	4.22	72.4%
2-1/2	0.375	3.16	75.6%
2-1/2	0.313	2.24	79.0%
2-1/2	0.283	1.85	80.7%
2-1/2	0.263	1.61	81.9%
2-1/2	0.250	1.46	82.6%
2-1/2	0.225	1.19	84.2%
2-1/2	0.207	1.02	85.3%
2-1/2	0.192	0.88	86.2%
2-1/2	0.177	0.75	87.2%
2-1/2	0.162	0.63	88.2%
2-1/2	0.148	0.53	89.1%
2-1/4	1.000	20.61	47.9%
2-1/4	0.750	12.37	56.2%
2-1/4	0.688	10.58	58.7%
2-1/4	0.625	8.90	61.2%
2-1/4	0.563	7.34	64.0%
2-1/4	0.500	5.91	66.9%
2-1/4	0.438	4.62	70.1%
2-1/4	0.375	3.46	73.4%
2-1/4	0.313	2.46	77.1%
2-1/4	0.283	2.04	78.9%
2-1/4	0.263	1.77	80.2%
2-1/4	0.250	1.61	81.0%
2-1/4	0.225	1.31	82.6%
2-1/4	0.207	1.12	83.9%
2-1/4	0.192	0.97	84.9%
2-1/4	0.177	0.83	85.9%
2-1/4	0.162	0.70	87.0%
2-1/4	0.148	0.59	88.0%
2-1/4	0.135	0.49	89.0%
2	1.000	22.49	44.4%
2	0.750	13.57	52.9%
2	0.688	11.62	55.4%
2	0.625	9.79	58.0%
2	0.563	8.09	60.9%
2	0.500	6.53	64.0%
2	0.438	5.11	67.3%
2	0.375	3.84	70.9%
2	0.313	2.73	74.8%
2	0.283	2.26	76.7%
2	0.263	1.97	78.1%
2	0.250	1.79	79.0%
2	0.225	1.46	80.8%
2	0.207	1.25	82.1%
2	0.192	1.08	83.2%
2	0.177	0.92	84.4%
2	0.162	0.78	85.6%
2	0.148	0.65	86.7%
2	0.135	0.55	87.6%
2	0.120	0.44	89.0%
1-3/4	1.000	24.76	40.5%
1-3/4	0.750	15.03	49.0%
1-3/4	0.688	12.90	51.6%
1-3/4	0.625	10.88	54.3%
1-3/4	0.563	9.01	57.3%
1-3/4	0.500	7.29	60.5%
1-3/4	0.438	5.71	64.0%
1-3/4	0.375	4.30	67.8%
1-3/4	0.313	3.07	71.9%
1-3/4	0.283	2.55	74.1%
1-3/4	0.263	2.22	75.6%
1-3/4	0.250	2.02	76.6%
1-3/4	0.225	1.65	78.5%
1-3/4	0.207	1.41	80.0%
1-3/4	0.192	1.22	81.2%
1-3/4	0.177	1.04	82.5%
1-3/4	0.162	0.88	83.8%
1-3/4	0.148	0.74	85.0%
1-3/4	0.135	0.62	86.2%
1-3/4	0.120	0.49	87.6%
1-1/2	1.000	27.57	36.0%
1-1/2	0.750	16.86	44.4%
1-1/2	0.688	14.50	47.0%
1-1/2	0.625	12.27	49.8%
1-1/2	0.563	10.18	52.8%
1-1/2	0.500	8.25	56.3%
1-1/2	0.438	6.48	59.9%
1-1/2	0.375	4.90	64.0%
1-1/2	0.313	3.50	68.5%
1-1/2	0.283	2.91	70.8%
1-1/2	0.263	2.54	72.4%
1-1/2	0.250	2.31	73.4%
1-1/2	0.225	1.89	75.6%

Clear Opening of Space Inch	Diameter of Rod or Wire Inch	Steel Weight Pounds Per Sq. Ft.	Open Area
1-1/2	0.207	1.62	77.2%
1-1/2	0.192	1.40	78.6%
1-1/2	0.177	1.20	80.0%
1-1/2	0.162	1.02	81.5%
1-1/2	0.148	0.85	82.8%
1-1/2	0.135	0.72	84.2%
1-1/2	0.120	0.57	85.7%
1-3/8	0.750	17.97	41.9%
1-3/8	0.688	15.47	44.4%
1-3/8	0.625	13.10	47.3%
1-3/8	0.563	10.88	50.4%
1-3/8	0.500	8.83	53.8%
1-3/8	0.438	6.95	57.6%
1-3/8	0.375	5.26	61.7%
1-3/8	0.313	3.77	66.4%
1-3/8	0.283	3.14	68.8%
1-3/8	0.263	2.74	70.5%
1-3/8	0.250	2.49	71.6%
1-3/8	0.225	2.04	73.9%
1-3/8	0.207	1.75	75.6%
1-3/8	0.192	1.52	77.0%
1-3/8	0.177	1.30	78.5%
1-3/8	0.162	1.10	80.0%
1-3/8	0.148	0.92	81.5%
1-3/8	0.135	0.78	82.9%
1-3/8	0.120	0.62	84.6%
1-1/4	0.750	19.22	39.1%
1-1/4	0.688	16.57	41.6%
1-1/4	0.625	14.06	44.4%
1-1/4	0.563	11.70	47.5%
1-1/4	0.500	9.51	51.0%
1-1/4	0.438	7.50	54.8%
1-1/4	0.375	5.69	59.2%
1-1/4	0.313	4.08	64.0%
1-1/4	0.283	3.40	66.5%
1-1/4	0.263	2.97	68.3%
1-1/4	0.250	2.70	69.4%
1-1/4	0.225	2.22	71.8%
1-1/4	0.207	1.90	73.6%
1-1/4	0.192	1.65	75.1%
1-1/4	0.177	1.42	76.7%
1-1/4	0.162	1.20	78.4%
1-1/4	0.148	1.01	79.9%
1-1/4	0.135	0.85	81.5%
1-1/4	0.120	0.68	83.2%
1-1/4	0.105	0.52	85.1%
1-1/8	0.750	20.68	36.0%
1-1/8	0.688	17.86	38.5%
1-1/8	0.625	15.17	41.3%
1-1/8	0.563	12.65	44.4%
1-1/8	0.500	10.30	47.9%
1-1/8	0.438	8.14	51.8%
1-1/8	0.375	6.19	56.3%
1-1/8	0.313	4.45	61.2%
1-1/8	0.283	3.71	63.8%
1-1/8	0.263	3.25	65.7%
1-1/8	0.250	2.96	66.9%
1-1/8	0.225	2.43	69.4%
1-1/8	0.207	2.08	71.3%
1-1/8	0.192	1.81	73.0%
1-1/8	0.177	1.55	74.7%
1-1/8	0.162	1.32	76.4%
1-1/8	0.148	1.11	78.1%
1-1/8	0.135	0.93	79.7%
1-1/8	0.120	0.74	81.7%
1-1/8	0.105	0.58	83.7%
1-1/8	0.092	0.45	85.5%
1	0.750	22.38	32.6%
1	0.688	19.37	35.1%
1	0.625	16.49	37.9%
1	0.563	13.78	41.0%
1	0.500	11.25	44.4%
1	0.438	8.91	48.4%
1	0.375	6.79	52.9%
1	0.313	4.90	58.0%
1	0.283	4.09	60.8%
1	0.263	3.58	62.7%
1	0.250	3.26	64.0%
1	0.225	2.69	66.6%
1	0.207	2.31	68.6%
1	0.192	2.01	70.4%
1	0.177	1.72	72.2%
1	0.162	1.46	74.0%
1	0.148	1.23	75.9%
1	0.135	1.04	77.6%
1	0.120	0.83	79.7%
1	0.105	0.64	81.9%
1	0.092	0.50	83.9%
1	0.080	0.38	85.7%

Clear Opening of Space Inch	Diameter of Rod or Wire Inch	Steel Weight Pounds Per Sq. Ft.	Open Area
7/8	0.625	18.06	34.0%
7/8	0.563	15.13	37.0%
7/8	0.500	12.38	40.5%
7/8	0.438	9.84	44.4%
7/8	0.375	7.52	49.0%
7/8	0.313	5.44	54.3%
7/8	0.283	4.55	57.1%
7/8	0.263	3.99	59.1%
7/8	0.250	3.64	60.5%
7/8	0.225	3.01	63.3%
7/8	0.207	2.58	65.3%
7/8	0.192	2.25	67.2%
7/8	0.177	1.93	69.2%
7/8	0.162	1.64	71.2%
7/8	0.148	1.38	73.5%
7/8	0.135	1.17	75.1%
7/8	0.120	0.93	77.3%
7/8	0.105	0.72	79.7%
7/8	0.092	0.56	81.9%
7/8	0.080	0.43	83.9%
3/4	0.625	19.98	29.7%
3/4	0.563	16.79	32.6%
3/4	0.500	13.79	36.0%
3/4	0.438	11.00	39.9%
3/4	0.375	8.44	44.4%
3/4	0.313	6.13	49.8%
3/4	0.283	5.15	52.7%
3/4	0.263	4.52	54.8%
3/4	0.250	4.12	56.3%
3/4	0.225	3.41	59.2%
3/4	0.207	2.93	61.4%
3/4	0.192	2.56	63.4%
3/4	0.177	2.20	65.5%
3/4	0.162	1.87	67.6%
3/4	0.148	1.58	69.8%
3/4	0.135	1.33	71.8%
3/4	0.120	1.07	74.3%
3/4	0.105	0.83	76.9%
3/4	0.092	0.65	79.3%
3/4	0.080	0.50	81.7%
5/8	0.563	18.87	27.7%
5/8	0.500	15.57	30.9%
5/8	0.438	12.47	34.6%
5/8	0.375	9.61	39.1%
5/8	0.313	7.03	44.4%
5/8	0.283	5.91	47.4%
5/8	0.263	5.20	49.5%
5/8	0.250	4.76	51.0%
5/8	0.225	3.94	54.0%
5/8	0.207	3.40	56.4%
5/8	0.192	2.97	58.5%
5/8	0.177	2.58	60.7%
5/8	0.162	2.18	63.1%
5/8	0.148	1.85	65.4%
5/8	0.135	1.56	67.6%
5/8	0.120	1.25	70.3%
5/8	0.105	0.98	73.4%
5/8	0.092	0.76	76.0%
5/8	0.080	0.58	78.6%
5/8	0.072	0.48	80.4%
5/8	0.063	0.37	82.5%
1/2	0.500	16.96	25.0%
1/2	0.438	14.42	28.4%
1/2	0.375	11.19	32.7%
1/2	0.313	8.24	37.9%
1/2	0.283	6.96	40.8%
1/2	0.263	6.14	42.9%
1/2	0.250	5.62	44.4%
1/2	0.225	4.68	47.5%
1/2	0.207	4.04	49.8%
1/2	0.192	3.54	52.2%
1/2	0.177	3.06	54.5%
1/2	0.162	2.61	57.1%
1/2	0.148	2.22	59.5%
1/2	0.135	1.88	62.0%
1/2	0.120	1.51	65.0%
1/2	0.105	1.18	68.3%
1/2	0.092	0.93	71.3%
1/2	0.080	0.71	74.3%
1/2	0.072	0.58	76.4%
1/2	0.063	0.45	78.9%
7/16	0.438	15.40	25.0%
7/16	0.375	12.20	29.0%
7/16	0.313	9.03	34.0%
7/16	0.283	7.64	36.9%
7/16	0.263	6.75	39.0%
7/16	0.250	6.19	40.5%
7/16	0.225	5.16	43.6%
7/16	0.207	4.47	46.0%

Clear Opening of Space Inch	Diameter of Rod or Wire Inch	Steel Weight Pounds Per Sq. Ft.	Open Area
7/16	0.192	3.92	48.3%
7/16	0.177	3.40	50.7%
7/16	0.162	2.90	53.2%
7/16	0.148	2.47	55.8%
7/16	0.135	2.09	58.4%
7/16	0.120	1.69	61.5%
7/16	0.105	1.33	65.0%
7/16	0.092	1.04	68.3%
7/16	0.080	0.80	71.5%
7/16	0.072	0.66	73.7%
7/16	0.063	0.51	76.4%
3/8	0.375	13.20	25.0%
3/8	0.313	9.99	29.7%
3/8	0.283	8.48	32.5%
3/8	0.263	7.51	34.5%
3/8	0.250	6.89	36.0%
3/8	0.225	5.77	39.0%
3/8	0.207	5.00	41.5%
3/8	0.192	4.39	43.8%
3/8	0.177	3.82	46.1%
3/8	0.162	3.27	48.7%
3/8	0.148	2.79	51.4%
3/8	0.135	2.37	54.1%
3/8	0.120	1.92	57.4%
3/8	0.105	1.51	61.0%
3/8	0.092	1.18	64.5%
3/8	0.080	0.91	67.9%
3/8	0.072	0.75	70.4%
3/8	0.063	0.59	73.3%
3/8	0.054	0.44	76.4%
5/16	0.263	8.46	29.5%
5/16	0.250	7.78	30.9%
5/16	0.225	6.53	33.8%
5/16	0.207	5.68	36.2%
5/16	0.192	5.00	38.4%
5/16	0.177	4.36	40.8%
5/16	0.162	3.74	43.4%
5/16	0.148	3.20	46.0%
5/16	0.135	2.72	48.8%
5/16	0.120	2.21	52.2%
5/16	0.105	1.74	56.0%
5/16	0.092	1.37	59.6%
5/16	0.080	1.07	63.4%
5/16	0.072	0.88	66.1%
5/16	0.063	0.69	69.3%
5/16	0.054	0.51	72.7%
1/4	0.250	8.95	25.0%
1/4	0.225	7.55	27.7%
1/4	0.207	6.59	29.9%
1/4	0.192	5.82	32.0%
1/4	0.177	5.08	34.3%
1/4	0.162	4.38	36.8%
1/4	0.148	3.76	39.4%
1/4	0.135	3.21	42.2%
1/4	0.120	2.62	45.6%
1/4	0.105	2.07	49.6%
1/4	0.092	1.64	53.4%
1/4	0.080	1.28	57.4%
1/4	0.072	1.06	60.3%
1/4	0.063	0.83	63.8%
1/4	0.054	0.62	67.6%
1/4	0.047	0.48	70.9%
3/16	0.192	6.97	24.4%
3/16	0.177	6.12	26.5%
3/16	0.162	5.30	28.8%
3/16	0.148	4.57	31.3%
3/16	0.135	3.92	33.8%
3/16	0.120	3.22	37.2%
3/16	0.105	2.56	41.1%
3/16	0.092	2.04	45.1%
3/16	0.080	1.60	49.1%
3/16	0.072	1.33	52.2%
3/16	0.063	1.05	56.0%
3/16	0.054	0.79	60.3%
3/16	0.047	0.62	63.9%
3/16	0.041	0.48	67.3%
1/8	0.135	4.98	23.1%
1/8	0.120	4.19	26.0%
1/8	0.105	3.37	29.5%
1/8	0.092	2.71	33.2%
1/8	0.080	2.15	37.2%
1/8	0.072	1.79	40.3%
1/8	0.063	1.43	44.2%
1/8	0.054	1.09	48.8%
1/8	0.047	0.85	52.8%
1/8	0.041	0.67	56.7%
1/8	0.035	0.50	61.0%
1/8	0.032	0.43	63.4%

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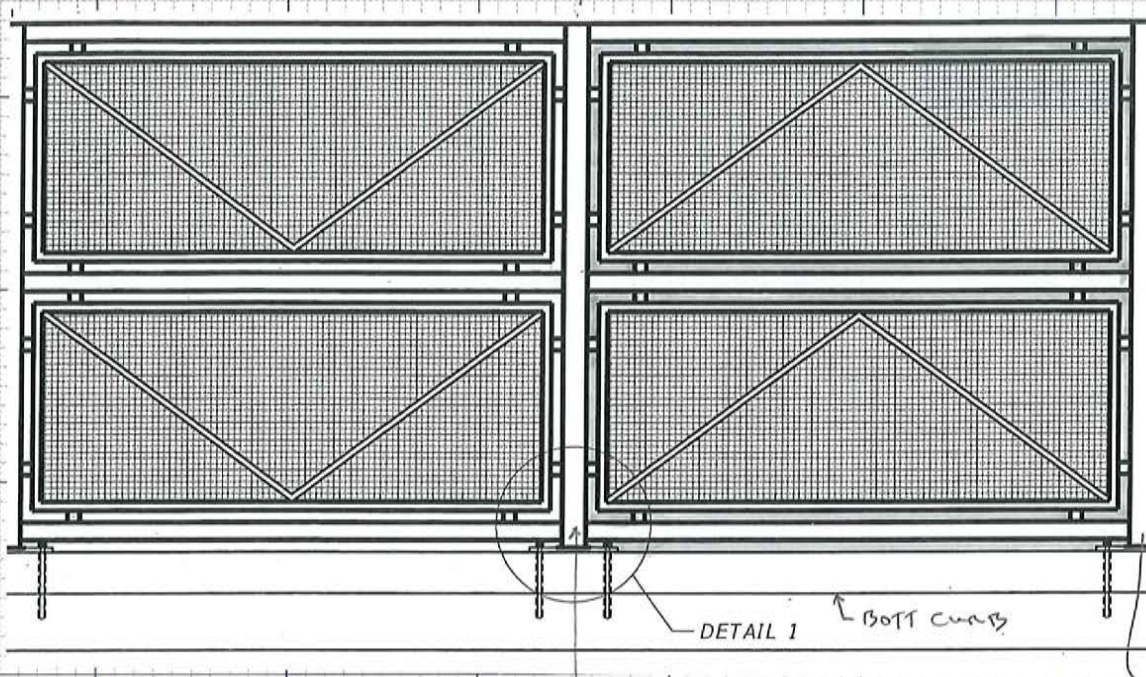
UNIT GEOMETRY



UNIT WEIGHTS

POLE:	HSS 4x4x5/16",	14.83 lb/ft
HORIZ:	HSS 3x3x1/8",	4.75 lb/ft
FRAME:	L 1½x1½x3/16",	1.80 lb/ft
DIAG:	FLAT 3/16"x1",	0.638 lb/ft
MESH:	4 MESH (1/4"x1/4"),	1.05 lb/sf
CLIPS:	HSS 2x2x1/4",	5.41 lb/ft

WT OF 1-8' UNIT

POLE = 14.83 (8'-0.58') = 110.0#
HORIZ = 4.75 (8'-0.33') = 36.4#
FRAME = 1.80 (2·7.33 + 2·2.67) = 36.0#
DIAG = 0.638 (4.4')(2) = 5.6#
MESH = 1.05 (7.33')(2.92') = 22.5#
CLIPS = 5.41 (0.17')(8) = 7.4#

Σ = 1 POLE + 3 HORIZ + 2 FRAME + 2 DIAG + 2 MESH + 2 CLIPS
= 362.2# (PER 8')
~45#/ft

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LOADS

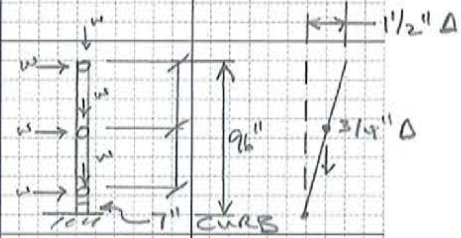
$w_{LL} = 0.050$ klf (13.8.2)

$P_{LL} = 0.200$ k → (LONGIT. ELEMENTS)

$P_{LL} = 0.2 + 0.05(8') = 0.600$ k (POSTS)

$w_{W} = 0.015$ ksf

3/4" PΔ effect (0.06')



BASE OF POST (ASSUME 8' FENCE HT - CONSERVATIVE)

$V_{uI} = 1.75(0.6) = 1.05$ k

$V_{uIII} = 1.4(0.015)(8')(8') = \underline{\underline{1.344 \text{ k}}}$ GOVERNS

$V_{uV} = 1.35(0.6) + 0.4(0.015)(8')(8') = 1.194$ k

$M_{uI} = 1.75(0.6)(5') = 5.25$ k·f

$M_{uIII} = 1.4(0.015)(8')(8')(4') = 5.38$ kf

$M_{uV} = 1.35(0.6)(5') + 0.4(0.015)(8')(8')(4') = \underline{\underline{5.59 \text{ k·f}}}$ GOVERNS

CHECK Pδ = 0.3k (0.06') = 0.02 k·f (negligible)

$P_{uI} = P_{uIII} = P_{uV} = 1.25(0.36) = \underline{\underline{0.45\text{k}}}$

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POST FLEXURE (6.12.2.2.2)

① YIELDING

$$\phi M_n = \phi F_y Z$$
$$= 1.0(36\ ksi)(5.59\ in^3)/12$$
$$= 16.77\ k\text{-}f$$

M_u = 5.59 k-f ok   C/D = 2.5

② FLANGE + WEB

→ COMPACT; THEREFORE OK BY INSPECTION

POST SHEAR (6.10.9.2)

$$\phi V_n = \phi 0.58 F_y D t C$$
$$= 1.0(0.58)(36\ ksi)(3.5")(0.5")(1.0)$$
$$= 36.5\ k$$

V_u = 1.34 k   ok   C/D = 27

FIGG	Project: FIU	Date: 9/16	Page / Of
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BASE PLATE DESIGN

- Assume PL 10" x 8" x 7/8"

$\phi M_n = \phi F_y Z$

$Z = \dfrac{b t^2}{4} = \dfrac{10(0.875)^2}{4} = 1.914 \ in^3$

$\phi M_n = \dfrac{1.0(36 \ ksi)(1.914 \ in^3)}{4}\left(\dfrac{1}{12}\right) = 1.436 \ k \cdot f$

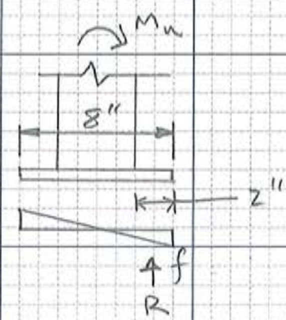
AT POST, $M_u = 5.59 \ k \cdot f$

$S_x = \dfrac{10(8)^2}{6} = 106.7 \ in^3$

$f = \dfrac{M_u}{S_x} = 0.63 \ ksi$

$M_u = f(2")(10")(1")/12$

$= 1.05 \ k \cdot f$ <u>ok</u>



C/D = 1.36

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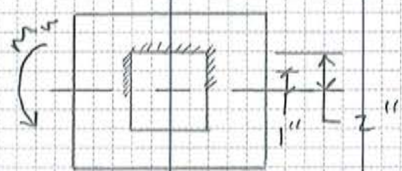
BASE PLATE WELD DESIGN (6.13.3.2.4)

$\phi R_n = 0.6\, \phi_{e2} F_{e70}\, t\, l$

$\phi_{e2} = 0.80$

$t = \frac{\sqrt{2}}{2}\left(\frac{4}{16}\right) = 0.177''$



$\phi R_n = 0.6(0.8)(70\ ksi)(0.177'')$

$= 5.95\ k/in$

$\phi M_n = [5.95(4'')(2'') + 5.95(2'')(1'')(2)]\ /12$

$= 5.95\ k \cdot ft$

$M_u = 5.59\ k \cdot f$ OK $\quad C/D = 1.06$

USE 1/4" WELD

CHECK SHEAR

$\phi R_n = 5.59\ k/in\,(2'')(4)$

$= 44.7\ k$

$V_u = 1.34\ k$ OK $\quad C/D = 33$

FIGG	Project: FIG	Date: 9/16	Page / Of
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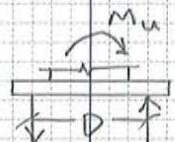
BASE PLATE BOLT DESIGN

- ASSUME 4 – 5/8" ϕ BOLTS
- USE EDGE DISTANCE OF 1¼" (6.13.2.6.6)

$$\phi T_n = \phi\, 0.76\, A_b F_{ub}$$

$$= 0.80(0.76)(0.307\ in^2)(45\ ksi)$$

$$= 8.4\ k$$



$$T_u = \frac{M}{2D} = \frac{5.59\ k\cdot f\,(12)}{2(8'' - 2.5'')}$$

2 × 1¼"

$$= 6.1\ k \quad \underline{\underline{ok}}$$

$$C/D = 1.38$$

CHECK PRYING ACTION (6.13.2.10.4)

$$Q_u = \left(\frac{3b}{8a} - \frac{t^3}{20}\right) P_u$$

$$b = \frac{8''}{2} - \frac{4''}{2} - 1.25'' = 0.75''$$

$$a = 1.25''$$

$$t = 0.875''$$

$$Q_u = \left(\frac{3(0.75)}{8(1.25)} - \frac{0.875^3}{20}\right)(6.1^k)$$

$$= 0.19\,(6.1^k)$$

$$= 1.16^k$$

$$P_u + Q_u = 7.26^k \quad \underline{\underline{OK}} \qquad C/D = 1.16$$

P_u = 6.1^k

US Nut Size Table

Size	Diam.*		Height			
	Hex Nut	Machine Screw Nut	Hex Nut	Jam Nut	Nylock Nut	Machine Screw Nut
0	-	5/32	-	-	-	3/64
1	-	5/32	-	-	-	3/64
2	-	3/16	-	-	9/64	1/16
3	-	3/16	-	-	9/64	1/16
4	-	1/4	-	-	9/64	3/32
6	-	5/16	-	-	11/64	7/64
8	-	11/32	-	-	15/64	1/8
10	-	3/8	-	-	15/64	1/8
12	-	7/16	-	-	5/16	5/32
1/4	7/16	7/16	7/32	5/32	5/16	3/16
5/16	1/2	9/16	17/64	3/16	11/32	7/32
3/8	9/16	5/8	21/64	7/32	29/64	1/4
7/16	11/16	-	3/8	1/4	29/64	-
1/2	3/4	-	7/16	5/16	19/32	-
9/16	7/8	-	31/64	5/16	41/64	-
5/8	15/16	-	35/64	3/8	3/4	-
3/4	1-1/8	-	41/64	27/64	7/8	-
7/8	1-5/16	-	3/4	31/64	63/64	-
1	1-1/2	-	55/64	35/64	1-3/64	-

* This is the diameter across the flats. It is also the size of wrench to use.

ANCHOR BOLT PULLOUT

REF: ACI 318-14

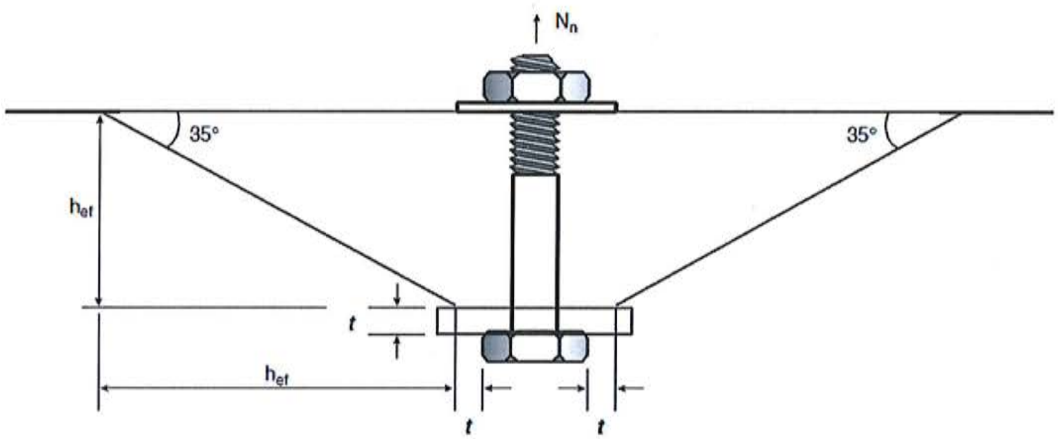


Figure 34-1 Effect of Washer Plate on Projected Area of Concrete Breakout

$P_u := 7.26 \cdot k$

$\phi_{bo} := 0.70$ $\qquad \phi_{po} := 0.70$ (17.3.3)

$f_c := 5500 \cdot psi$ $\qquad k_c := 24$ *(24 for cast-in anchors, 17 for post-installed anchors)*

$d_{bolt} := 0.625 \cdot in$ $\qquad h_{ef} := 6 \cdot in$

$A_{bolt} := 0.25 \cdot \pi \cdot d_{bolt}^2$ $\qquad A_{bolt} = 0.307\,in^2$

$d_{nut} := \left(\frac{15}{16}\right) \cdot in$ across flats

$s_{nut} := \frac{d_{nut}}{2 \cdot \cos(30 \cdot deg)}$ $\qquad s_{nut} = 0.541\,in$ length of side of hexnut

$A_{nut} := \left(\frac{3 \cdot \sqrt{3}}{2}\right) \cdot s_{nut}^2$ $\qquad A_{nut} = 0.761\,in^2$

$A_{brg} := A_{nut} - A_{bolt}$ $\qquad A_{brg} = 0.454\,in^2$

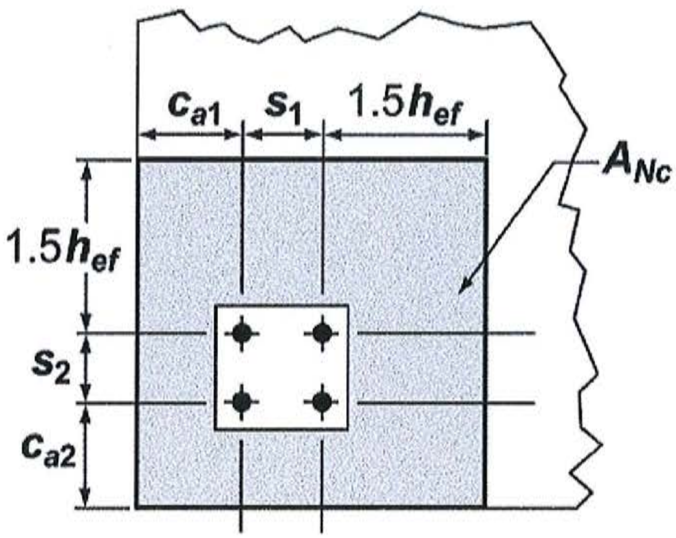
$t_{plate} := 0 \cdot in$

Breakout Strength (17.4.2)

$d_{plate} := d_{nut} + 2 \cdot t_{plate} = 0.938 \cdot in$

$N_b := k_c \cdot \sqrt{\frac{f_c}{psi}} \cdot \left(\frac{h_{ef}}{in}\right)^{1.5} \cdot lbf$ $\boxed{N_b = 26 \cdot k}$ single anchor and without modification factors (see next page)

Anchor Group Geometry



$A_{Nc} = (c_{a1} + s_1 + 1.5h_{ef})(c_{a2} + s_2 + 1.5h_{ef})$
if c_{a1} and $c_{a2} < 1.5h_{ef}$
and s_1 and $s_2 < 3h_{ef}$

$s_1 := 7.5 \cdot in$ $s_2 := 5.5 \cdot in$ $c_{a2} := 2.25 \cdot in$ $c_{a1} := 1.5 \cdot h_{ef}$ $c_{amin} := \min(c_{a1}, c_{a2})$

$A_{Nc} := (c_{a1} + s_1 + c_{a1}) \cdot (c_{a2} + s_2 + c_{a2})$ $A_{Nc} = 1.771\, ft^2$ *will change depending on anchoring conditions - this set-up is for a curb*

$A_{Nco} := 9 \cdot h_{ef}^2$ $A_{Nco} = 2.25\, ft^2$

Eccentric Load Modification Factor (17.4.2.4)

$$e_N := \frac{s_2}{2}$$

$$\psi_{ecN} := \min\left[\left(1 + \frac{2 \cdot e_N}{3 \cdot h_{ef}}\right)^{-1}, 1.0\right]$$

$$\psi_{ecN} = 0.77$$

Edge Effects Modification Factor (17.4.5.4)

$$\psi_{edN} := \begin{cases} 1.0 & \text{if } c_{amin} \geq 1.5 \cdot h_{ef} \\ 0.7 + 0.3 \cdot \dfrac{c_{amin}}{1.5 \cdot h_{ef}} & \text{if } c_{amin} < 1.5 \cdot h_{ef} \end{cases}$$

$$\psi_{edN} = 0.78$$

Cracking Modification Factor (17.4.2.6)

$\psi_{cN} := 1.25$ 1.25 for cast-in anchors; 1.40 for post-installed anchors

Post Installed Modification Factor (17.4.2.7)

$\psi_{cpN} := 1.0$ 1.0 unless post-installed anchors are used

$$\phi N_{cb} := \phi_{bo} \cdot \left(\frac{A_{Nc}}{A_{Nco}}\right) \cdot \psi_{ecN} \cdot \psi_{edN} \cdot \psi_{cN} \cdot \psi_{cpN} \cdot N_b \qquad \boxed{\phi N_{cb} = 10.7 \cdot k}$$

Pullout Strength (17.4.3.1, 17.4.3.4)

$$\psi_{cP} := 1.0$$

$$\phi N_{pn} := \phi_{po} \cdot \psi_{cP} \cdot A_{brg} \cdot 8 \cdot f_c \qquad \boxed{\phi N_{pn} = 14.0\,k}$$

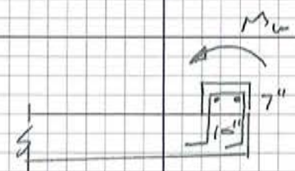
$$CD := \frac{\min(\phi N_{cb}, \phi N_{pn})}{P_u} = 1.47$$

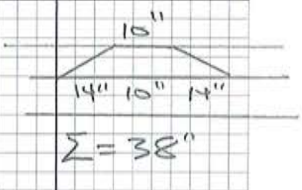
CURB REBAR

FLEXURE

$M_u = \dfrac{5.59 \text{ k}\cdot\text{ft}}{3.17'} = 1.76 \text{ k}\cdot\text{f/ft}$

↳ 38" DISTRIBUTION OF BENDING





- Assume #4 bars @ 12"

$d = 10" - 2.25" - 0.25" = 7.5"$

↳ 1/2 #4 bar

$a = \dfrac{A_s f_y}{0.85 f'_c b} = \dfrac{0.20(60)}{0.85(8.5)(12)} = 0.138"$

$\phi M_n = \dfrac{0.9(0.20)(60)}{12}\left(7.5 - \dfrac{0.138}{2}\right)$

$= 6.69 \text{ k}\cdot\text{f/ft}$ OK

$C/D = 3.8$

USE #4 @ 12" AND

2#4 @ each post

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HORIZONTAL HSS

$V_{u\,I} = 1.75[(0.050\text{ klf})(96"-4") + 0.2\text{ k}](0.5) = 0.51\text{ k}$ (GOVERNS)

$V_{u\,III} = 1.4(0.015\text{ ksf})(3.5')(8')(0.5) = 0.29\text{ k}$

$V_{u\,V} = 0.51\left(\frac{1.35}{1.75}\right) + 0.29\left(\frac{0.4}{1.4}\right) = 0.48\text{ k}$

$M_{u\,I} = \frac{1.75(0.050)(7.67)^2}{8} + \frac{1.75(0.2)(7.67)}{4}$

$= 0.64 + 0.67 = 1.31\text{ k}\cdot\text{f}$ (GOVERNS)

$M_{u\,III} = \frac{1.4(0.015)(3.5)(7.67)^2}{8} = 0.54\text{ k}\cdot\text{f}$

$M_{u\,V} = 1.31\left(\frac{1.35}{1.75}\right) + 0.54\left(\frac{0.4}{1.4}\right) = 1.16\text{ k}\cdot\text{f}$

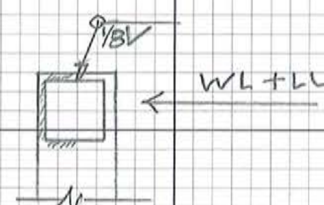
WELD SHEAR

$\phi R_n = \phi_{ez}\, 0.6\, F_{e70}\, t\, l$

$= 0.80(0.6)(70)(0.707)(0.125")$

$= 3\text{ k/in}$ FOR 1/8" WELD

(OK by insp.)



WELD BENDING

$\phi R_n = 3\text{ k/in}[(3")(1.5") + 2(1.5")(0.75")]/12$

$= 1.69\text{ k}\cdot\text{f}$ OK $\quad C/D = 1.29$

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HORIZONTAL HSS

- 3 x 3 x 1/8"

$\phi M_n = \phi F_y Z$

$= 1.0 (36\ ksi)(1.40\ in^3)/12$

$= 4.2\ k \cdot f$ OK C/D = 3.2

DEFLECTION

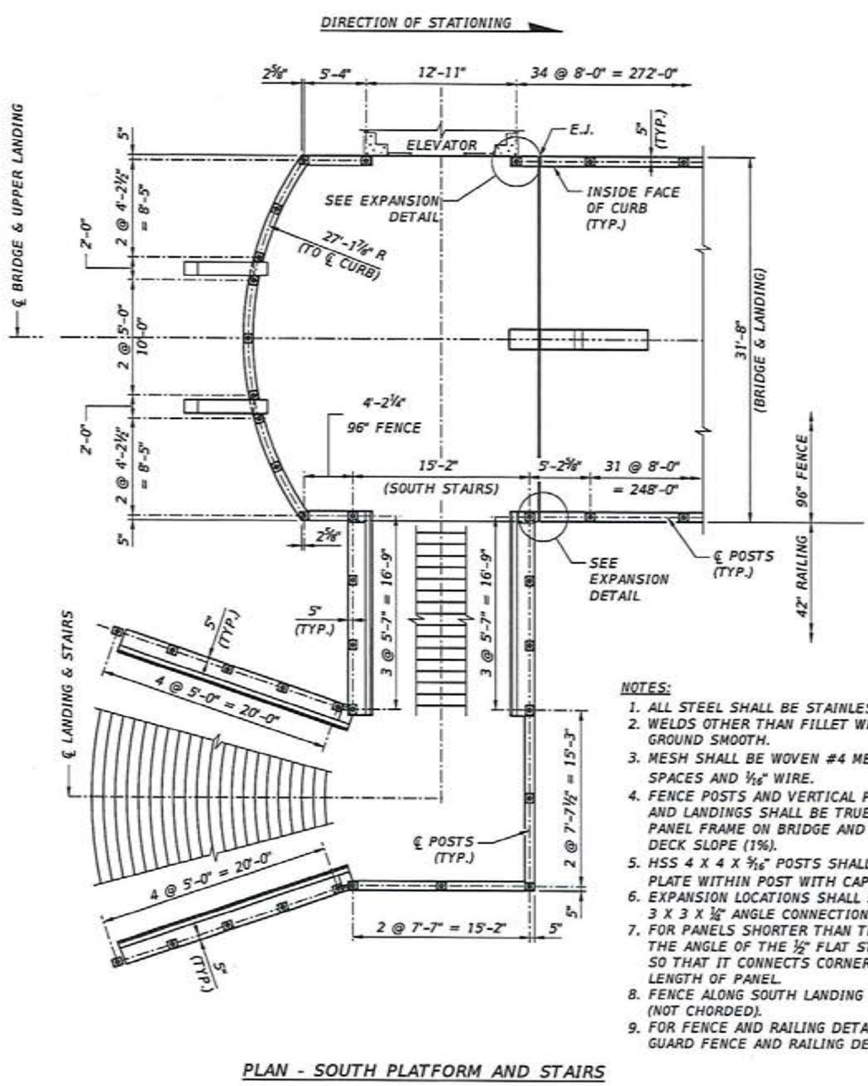
- ASSUME SIMPLE SPAN END CONDITIONS (CONSERVATIVE)

$\Delta_{dist} = \frac{5(0.050)(92'')^4}{384(29000)(1.78)} = 0.90''$

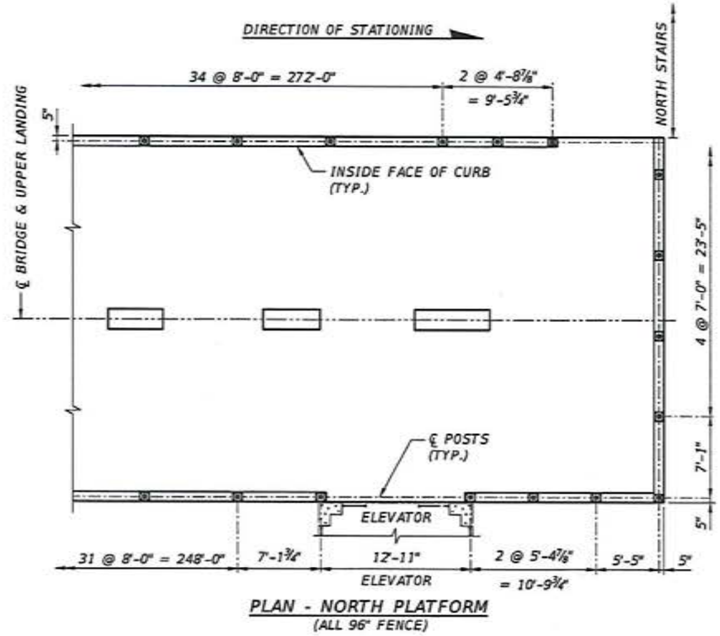
$\Delta_{point} = \frac{0.2(92'')^3}{48(29000)(1.78)} = 0.06''$

$\Sigma = 0.96'' < 1.5''$ (SDG 6.8.4) OK

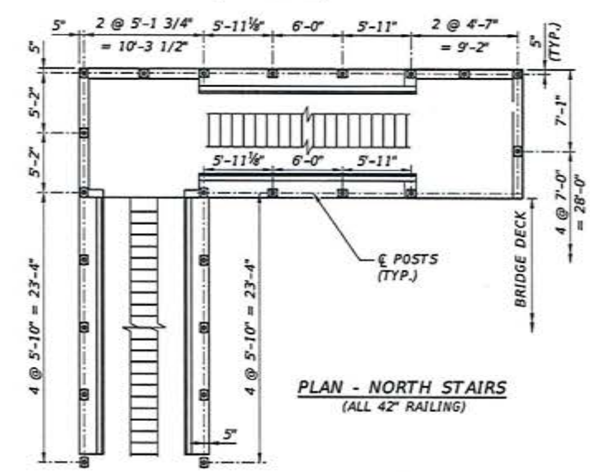
C/D = 1.56



PLAN - SOUTH PLATFORM AND STAIRS



PLAN - NORTH PLATFORM
(ALL 96" FENCE)



PLAN - NORTH STAIRS
(ALL 42" RAILING)

NOTES:

1. ALL STEEL SHALL BE STAINLESS STEEL.
2. WELDS OTHER THAN FILLET WELDS SHALL BE GROUND SMOOTH.
3. MESH SHALL BE WOVEN #4 MESH WITH 3/16" CLEAR SPACES AND 1/16" WIRE.
4. FENCE POSTS AND VERTICAL PANEL FRAMES ON BRIDGE AND LANDINGS SHALL BE TRUE VERTICAL. TRANSVERSE PANEL FRAME ON BRIDGE AND LANDING SHALL BE AT DECK SLOPE (1%).
5. HSS 4 X 4 X 5/16" POSTS SHALL BE CAPPED WITH PLATE WITHIN POST WITH CAP FLUSH AT TOP OF POST.
6. EXPANSION LOCATIONS SHALL SHALL NOT HAVE 3 X 3 X 1/4" ANGLE CONNECTIONS ON VERTICAL SIDE.
7. FOR PANELS SHORTER THAN THE TYPICAL 8'-0", THE ANGLE OF THE 1/2" FLAT STRIP SHALL BE ADJUSTED SO THAT IT CONNECTS CORNER OF PANEL TO MID-LENGTH OF PANEL.
8. FENCE ALONG SOUTH LANDING SHALL FOLLOW CURVE (NOT CHORDED).
9. FOR FENCE AND RAILING DETAILS, SEE MISSILE GUARD FENCE AND RAILING DETAILS (2 OF 2).

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

ENGINEER OF RECORD:
FIGG
424 North Calhoun Street
Tallahassee, Florida 32301
FLORIDA CERTIFICATE OF AUTHORIZATION NO. 5618
W. DENNEY PATE, P.E. - P.E. NO. 34332

DRAWN BY: SJF
CHECKED BY: JDS
DESIGNED BY: JDS
CHECKED BY: MF

FIU FLORIDA INTERNATIONAL UNIVERSITY

ROAD NO.	COUNTY	PROJECT ID
	MIAMI-DADE	434688-1-58-01

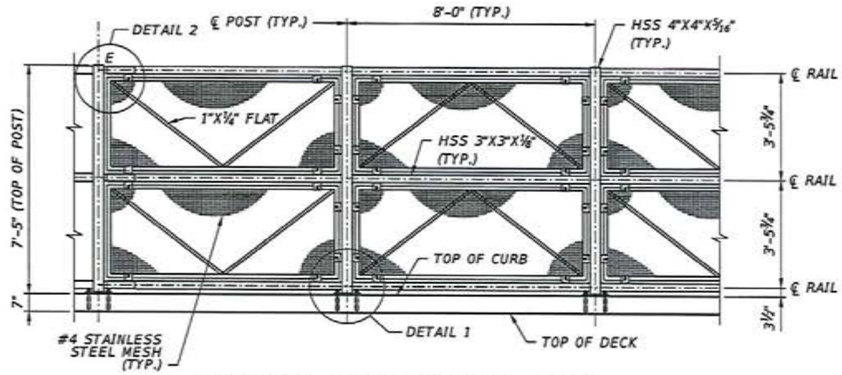
SHEET TITLE: MISSILE GUARD FENCE AND RAILING DETAILS (1 OF 2)

PROJECT NAME: UNIVERSITYCITY PROSPERITY PROJECT

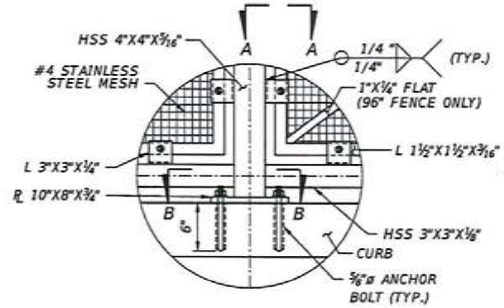
SHEET NO. B-106

Plotted By: lcavanaugh 9/26/2016 5:05:35 PM G:\43468815801\struct\B1_104_Fence_Details1.DGN

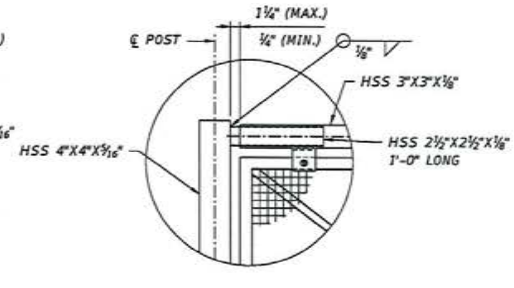
90% SUBMITTAL - NOT FOR CONSTRUCTION - SEPTEMBER 2016



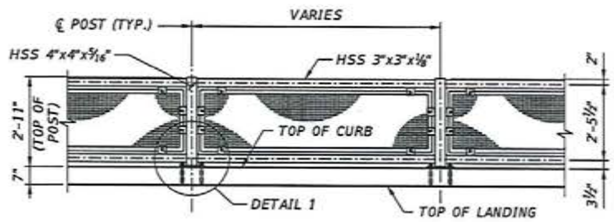
ELEVATION - 96" MISSILE GUARD FENCE



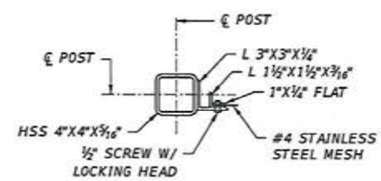
DETAIL 1
(LANDING LOCATION SHOWN, STAIR LOCATION SIMILAR)



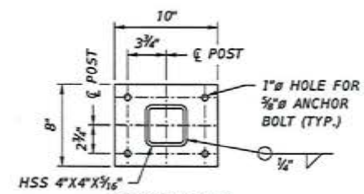
DETAIL 2
EXPANSION DETAIL
(SELECTED LOCATIONS)



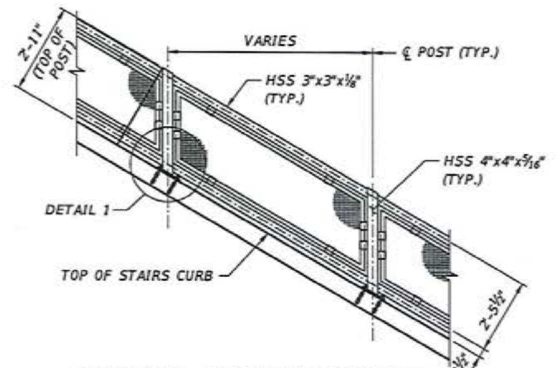
ELEVATION - 42" RAILING AT LANDINGS



SECTION A-A



SECTION B-B



ELEVATION - 42" RAILING AT STAIRS

NOTES:

1. FOR POST LOCATIONS AND NOTES, SEE MISSILE GUARD FENCE AND RAILING DETAILS SHEET (1 OF 2).
2. SUBMITTALS: THE CONTRACTOR SHALL SUBMIT THE FOLLOWING FOR THE ENGINEER'S APPROVAL PRIOR TO FABRICATION.
   A. SHOP DRAWINGS WITH COMPLETE DETAILS INCLUDING RAIL, BRACKET, SPLICES AND EXPANSION JOINT LOCATIONS. INDICATE COMPONENT DETAILS, MATERIALS, FINISHES, CONNECTIONS AND JOINING METHODS, AND THE RELATIONSHIP TO ADJOINING WORK.
   B. SUMMARY OF THE MATERIALS PROPOSED FOR THE RAIL SYSTEM, INCLUDING MILL ANALYSIS WITH CERTIFICATION BY THE PRODUCER THAT THE PARTS MEET THE SPECIFICATIONS CALLED FOR PER SECTION 965-2 OF THE SPECIFICATIONS.
   C. THE MANUFACTURER'S ENGINEERING DESIGN AND DATA FOR THE RAIL SYSTEM AND COMPONENTS SIGNED AND SEALED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF FLORIDA.
   D. THE MANUFACTURER'S INSTALLATION INSTRUCTIONS AND PRODUCT DATA.
3. INSTALL IN ACCORDANCE WITH THE APPROVED SHOP DRAWINGS AND MANUFACTURER'S INSTRUCTIONS.

REVISIONS

DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

ENGINEER OF RECORD:
FIGG
424 North Calhoun Street
Tallahassee, Florida 32301
FLORIDA CERTIFICATE OF AUTHORIZATION NO. 5618
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DRAWN BY: SJF
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DESIGNED BY: JDS
CHECKED BY: MF

FIU FLORIDA INTERNATIONAL UNIVERSITY

ROAD NO.	COUNTY	PROJECT ID
	MIAMI-DADE	434688-1-58-01

SHEET TITLE: MISSILE GUARD FENCE AND RAILING DETAILS (2 OF 2)

PROJECT NAME: UNIVERSITYCITY PROSPERITY PROJECT

SHEET NO. B-107

Plotted By: lcavanaugh 9/26/2016 5:05:36 PM G:\43468815801\struct\B1_105_Fence_DetailsII.DGN

Section VIII

Drainage Support

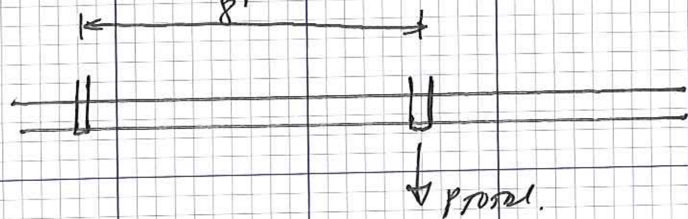
FIGG			
Project FIU		Date	Page ___ Of ___
Project Number 2262.03		Designed MF	
Description Drainage Support.		Checked	

Drainage Supports

Assume 8' spacing.

8" PVC pipe schedule 80

$w = 8.05\ lb/ft$



$P_{PVC\ pipe} = (8.05\ lb/ft)(8\ ft) = 64.4\ lbs$

$P_{WATER} = \frac{\pi(4)^2}{144}(8\ ft)(62.4\ lb/ft^3) = 180\ lbs$ (conservative)

$P_{TOTAL} = 245\ lbs$ (working load)

@ 100 °F the maximum support spacing is 9½ ft., therefore the pipe is ok! (see next page for reference).

PVC Pipes and Support Spacing

Distance between support for PVC pipes

Maximum distance between PVC - Polyvinyl Chloride - pipes supports depends on operating temperature:

PVC Pipe - Schedule 40

Maximum Support Spacing *(feet)*			
NPS *(inches)*	Operating Temperature *(°F)*		
	60	100	140
1/2	4 1/2	4	2 1/2
3/4	5	4	2 1/2
1	5 1/2	4 1/2	2 1/2
1 1/4	5 1/2	5	3
1 1/2	6	5	3
2	6	5	3
3	7	6	3 1/2
4	7 1/2	6 1/2	4
6	8 1/2	7 1/2	4 1/2
8	9	8	4 1/2

PVC Pipe - Schedule 80

Maximum Support Spacing *(feet)*			
NPS *(inches)*	Operating Temperature *(°F)*		
	60	100	140
1/2	5	4 1/2	2 1/2
3/4	5 1/2	4 1/2	2 1/2
1	6	5	3
1 1/2	6 1/2	5 1/2	3 1/2
2	7	6	3 1/2
3	8	7	4
4	9	7 1/2	4 1/2
6	10	9	5
8	11	9 1/2	5 1/2

- *1 ft (foot) = 0.3048 m*
- *T(°C) = 5/9[T(°F) - 32]*

Related Topics

- Dimensions - Sizes and dimensions of pipes and tubes, and their fittings - inside and outside diameter, weight and more

Related Documents

- PVC Pipes Schedule 40 - Friction loss and Velocity Diagrams - Friction loss *(psi/100 ft)* and velocity for water flow in plastic PVC pipe schedule 40
- Hangers - Support Spacing and Rod Size for Horizontal Pipes - Recommended maximum support span between hangers - and rod sizes for straight horizontal pipes
- PVC Pipes - Friction Loss and Flow Velocities Schedule 40 - Water flow in thermoplastic PVC and CPVC pipes Schedule 40 - friction loss *(ft/100 ft, psi/100 ft)* and flow velocities at dimensions ranging 1/2 to 16 inches
- PVC Pipes - Friction Loss and Flow Velocities Schedule 80 - Water flow in thermoplastic PVC and CPVC pipes Schedule 80 - friction loss *(ft/100 ft, psi/100 ft)* and flow velocities at dimensions ranging 1/2 to 16 inches

B3180 - Standard Pipe Strap (TOLCO Fig. 20)

Size Range: 1/2" (15mm) thru 8" (200mm) pipe

Material: Steel

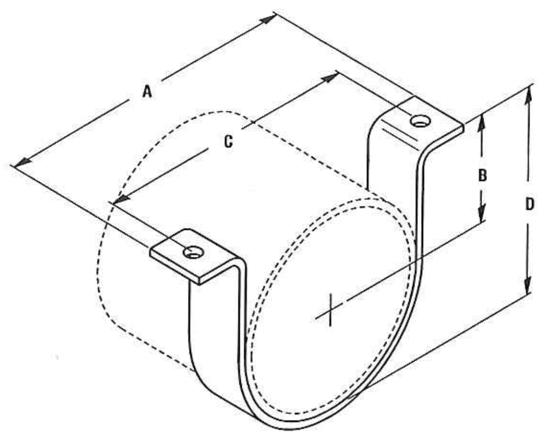
Function: Recommended for supporting pipe with fittings vertically or horizontally to walls or ceiling.

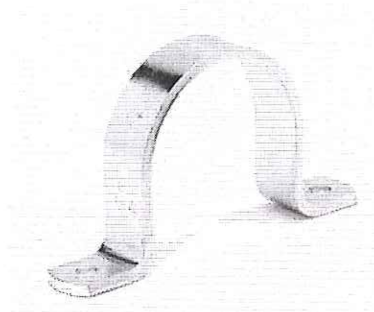
Approvals: Conforms to Federal Specification WW-H-171E & A-A-1192A, Type 26 and Manufacturers Standardization Society ANSI/MSS SP-69 & SP-58, Type 26.

Finish: Plain

Note: Available in Electro-Galvanized and HDG finish or Stainless Steel materials.

Order By: Part number, pipe size and material/finish





Part No.	Pipe Size in.	Pipe Size (mm)	A in.	A (mm)	B in.	B (mm)	C in.	C (mm)	D in.	D (mm)	Hole Size in.	Hole Size (mm)	Max. Rec. Load Lbs.	Max. Rec. Load (kN)	Approx. Wt./100 Lbs.	Approx. Wt./100 (kg)
B3180-1/2	1/2"	(15)	3 7/8"	(98.4)	3/4"	(19.0)	3 1/16"	(77.8)	15/32"	(11.9)	7/16	(11.1)	410	(1.82)	16	(7.2)
B3180-3/4	3/4"	(20)	4"	(101.6)	13/16"	(20.6)	3 1/8"	(79.4)	15/16"	(33.3)	7/16"	(11.1)	410	(1.82)	21	(9.5)
B3180-1	1"	(25)	4 9/16"	(115.9)	7/8"	(22.2)	3 3/8"	(85.7)	1 1/2"	(38.1)	7/16"	(11.1)	410	(1.82)	26	(11.8)
B3180-1 1/4	1 1/4"	(32)	4 15/16"	(125.4)	1"	(25.4)	3 3/4"	(95.2)	1 7/8"	(47.6)	7/16"	(11.1)	410	(1.82)	30	(13.6)
B3180-1 1/2	1 1/2"	(40)	5 3/16"	(131.8)	1 3/16"	(30.2)	4 1/4"	(107.9)	2 1/8"	(54.6)	7/16"	(11.1)	410	(1.82)	33	(14.9)
B3180-2	2"	(50)	5 3/4"	(146.0)	1 7/16"	(36.5)	4 3/4"	(120.6)	2 5/8"	(66.7)	7/16"	(11.1)	410	(1.82)	38	(17.2)
B3180-2 1/2	2 1/2"	(65)	6 1/4"	(158.7)	1 11/16"	(42.9)	5 1/4"	(133.3)	3 1/8"	(79.4)	7/16"	(11.1)	610	(2.71)	102	(46.2)
B3180-3	3"	(75)	6 7/8"	(174.6)	2"	(50.8)	5 7/8"	(149.2)	3 3/4"	(95.2)	7/16"	(11.1)	610	(2.71)	118	(53.5)
B3180-3 1/2	3 1/2"	(90)	7 3/8"	(187.3)	2 1/4"	(57.1)	6 3/8"	(161.9)	4 1/4"	(107.9)	7/16"	(11.1)	610	(2.71)	130	(58.9)
B3180-4	4"	(100)	8 3/8"	(212.7)	2 1/2"	(63.5)	7"	(177.8)	4 3/4"	(120.6)	9/16"	(14.3)	725	(3.22)	159	(72.1)
B3180-5	5"	(125)	9 7/16"	(239.7)	3 1/16"	(77.8)	7 7/8"	(200.0)	5 13/16"	(147.6)	9/16"	(14.3)	725	(3.22)	191	(86.6)
B3180-6	6"	(150)	10 1/2"	(266.7)	3 5/8"	(92.1)	8 7/8"	(225.4)	6 7/8"	(174.6)	9/16"	(14.3)	725	(3.22)	234	(106.1)
B3180-8	8"	(200)	14"	(355.6)	4 5/8"	(117.5)	11 1/2"	(292.1)	9"	(228.6)	11/16"	(17.5)	900	(4.00)	446	(202.3)

All dimensions in charts and on drawings are in inches. Dimensions shown in parentheses are in millimeters unless otherwise specified.