Time Step Details Report

January 22, 2020 1:56:47 pm

PGSplice™ (x64)

Version 4.1.6 - Built on Jan 17 2020

Washington State Department of Transportation

Texas Department of Transportation

Project Properties

Bridge Name	
Bridge ID	
Company	
Engineer	
Job Number	
Comments	
File	C:\Users\h9011nwh\Desktop\PG Super Analysis\H-3034 Spliced Girders_20200122.spl

Configuration

Configuration Name: WSDOT
Configuration Source: ftp://ftp.wsdot.wa.gov/public/bridge/Software/PGSplice/Version_4.1.0/WSDOT.pgz
Configuration Date Stamp: August 28, 2019 3:26:11 pm

Library	Entry	Source
Girders	NDOT 48"D	Project Library
Traffic Barriers	42" Single Slope	Master Library
Project Criteria	WSDOT - Spliced Girders based on AASHTO LRFD Bridge Design Specification, Eighth Edition 2017	Master Library
Vehicular Live Load	OL1	Master Library
Vehicular Live Load	OL1 (Neg Moment)	Master Library
Vehicular Live Load	OL2	Master Library
Vehicular Live Load	OL2 (Neg Moment)	Master Library
Vehicular Live Load	P13	Project Library
Load Rating Criteria	WSDOT based on The Manual for Bridge Evaluation, Second Edition 2011, with 2011-2016 interim provisions	Master Library
Ducts	4"	Master Library
Haul Trucks	HT50-72	Master Library

Notes

Symbol	Definition
L_r	Span Length of Segment at Release
L_l	Span Length of Segment during Lifting
L_{st}	Span Length of Segment during Storage
L_h	Span Length of Segment during Hauling
L_e	Span Length of Segment after Erection
L_s	Length of Span
FoS	Face of Support
ST	Section Transitions
STLF	Section Transitions, Left Face
STRF	Section Transitions, Right Face
IP	Interior Pier
CJ	Closure Joint
ITS	Interior Temporary Support
Debond	Point where bond begins for a debonded strand
PSXFR	Point of prestress transfer
Diaphragm	Location of a precast or cast in place diaphragm
Bar Cutoff	End of a reinforcing bar in the girder
Deck Bar Cutoff	End of a reinforcing bar in the deck
CS	Critical Section for Shear
SZB	Stirrup Zone Boundary
H	H from end of girder or face of support
1.5H	1.5H from end of girder or face of support
HP	Harp Point
Pick Point	Support point where girder is lifted from form
Bunk Point	Point where girder is supported during transportation

Status Items

Level	Description
Info	All Live Load Distribution Factors are computed using the Lever Rule.

Time Step Details

Span 1 Girder A, (STRF) -1.500 ft

Interval 31 : Time Step

Interval Details

Start (day)	Middle (day)	End (day)	Duration (day)
191	1921	3651	3460

Concrete Details

Component	Start		Middle		End	
	f_c (KSI)	E_c (KSI)	f_c (KSI)	E_c (KSI)	f_c (KSI)	E_c (KSI)
Girder	6.253	4943.848	6.398	4981.404	6.405	4983.322
Deck	5.723	4801.403	6.453	4995.671	6.462	4997.841

Component Net Section Properties

Component	E_k (KSI)	A_k (in^2)	I_k (in^4)	Y_k (in)	H (in)
Girder	4981.404	1471.799	397941.6	-25.651	48.000
Girder Rebar 1	29000.000	0.200	-	-43.250	-
Girder Rebar 2	29000.000	0.200	-	-43.250	-
Girder Rebar 3	29000.000	0.200	-	-43.250	-
Girder Rebar 4	29000.000	0.200	-	-43.250	-
Girder Rebar 5	29000.000	0.200	-	-43.250	-
Girder Rebar 6	29000.000	0.440	-	-46.125	-
Girder Rebar 7	29000.000	0.440	-	-46.125	-
Girder Rebar 8	29000.000	0.440	-	-46.125	-
Girder Rebar 9	29000.000	0.440	-	-46.125	-
Girder Rebar 10	29000.000	0.440	-	-46.125	-
Girder Rebar 11	29000.000	0.440	-	-46.125	-
Straight Strands	0.000	0.000	-	0.000	-
Harped Strands	28500.000	4.340	-	-43.500	-
Temporary Strands	0.000	0.000	-	0.000	-
Deck	4995.671	1524.880	8125.5	3.994	8.000
Deck Top Mat Individual Rebar	29000.000	3.200	-	6.750	-
Deck Top Mat Lump Sum Rebar	29000.000	0.000	-	0.000	-
Deck Bottom Mat Individual Rebar	29000.000	0.000	-	0.000	-
Deck Bottom Mat Lump Sum Rebar	29000.000	0.000	-	0.000	-
Tendon 1	28500.000	4.123	-	-30.750	-
Tendon 2	28500.000	4.123	-	-30.750	-
Tendon 3	28500.000	2.604	-	-11.500	-
Tendon 4	28500.000	2.604	-	-11.500	-

Y_k is measured positive upwards from the top of girder.

Composite Transformed Section Properties

$$A_{tr} = \frac{\sum E_k A_k}{E_{tr}} \quad Y_{tr} = \frac{\sum E_k A_k Y_k}{E_{tr} A_{tr}} \quad I_{tr} = \frac{\sum E_k (I_k + A_k (Y_{tr} - Y_k)^2)}{E_{tr}}$$

Component	E_{tr} (KSI)	A_{tr} (in^2)	I_{tr} (in^4)	Y_{tr} (in)	H (in)
Composite Section	4981.404	3182.696	1162292.3	-11.444	56.000

Y_{tr} is measured positive upwards from the top of girder (at the girder/deck interface).

Unrestrained creep deformation of concrete components due to loads applied in previous intervals

$$\Delta\varepsilon_c(i_e, i_b) = \sum_{j=1}^{i-1} \frac{\Delta P_c(j_m)}{A_c E_c(j_m)} [\chi(i_e)\psi(i_e, j_m) - \chi(i_b)\psi(i_b, j_m)]$$

$$\Delta\varphi_c(i_e, i_b) = \sum_{j=1}^{i-1} \frac{\Delta M_c(j_m)}{I_c E_c(j_m)} [\chi(i_e)\psi(i_e, j_m) - \chi(i_b)\psi(i_e, j_m)]$$

Loading Interval	Girder		Deck	
	Δε	Δφ (in^{-1})	Δε	Δφ (in^{-1})
1	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
2	(0.00 kip/(0.000 in^2)(4245.280 KSI))[(1)(	(0 kip-in/(0.0 in^4)(4245.280 KSI))[(1)(	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (

Loading Interval	Girder		Deck	
	Δε	Δφ (in^{-1})	Δε	Δφ (in^{-1})
	0.834361) - (1)(0.680366)] = 0	0.834361) - (1)(0.680366)] = 0.00000000	1)(0)] = 0	1)(0)] = 0.00000000
3	(0.00 kip/(1434.987 in^2)(4556.144 KSI))[(1)(0.646408) - (1)(0.53072)] = -5.61262e-22	(0 kip-in/(393435.5 in^4)(4556.144 KSI))[(1)(0.646408) - (1)(0.53072)] = 0.00000000	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
4	(0.00 kip/(1434.987 in^2)(4556.144 KSI))[(1)(0.646408) - (1)(0.53072)] = 3.32748e-21	(0 kip-in/(393435.5 in^4)(4556.144 KSI))[(1)(0.646408) - (1)(0.53072)] = 0.00000000	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
5	(0.00 kip/(1434.987 in^2)(4556.144 KSI))[(1)(0.646408) - (1)(0.53072)] = 2.36218e-21	(0 kip-in/(393435.5 in^4)(4556.144 KSI))[(1)(0.646408) - (1)(0.53072)] = 0.00000000	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
6	(19.08 kip/(1434.987 in^2)(4709.623 KSI)) [(1)(0.559802) - (1)(0.458115)] = 2.87079e-07	(353 kip-in/(393435.5 in^4)(4709.623 KSI))[(1)(0.559802) - (1)(0.458115)] = 0.00000002	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
7	(6.45 kip/(1434.987 in^2)(4811.824 KSI))[(1)(0.499146) - (1)(0.402212)] = 9.05215e-08	(119 kip-in/(393435.5 in^4)(4811.824 KSI))[(1)(0.499146) - (1)(0.402212)] = 0.00000001	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
8	(0.00 kip/(1434.987 in^2)(4833.926 KSI))[(1)(0.484898) - (1)(0.387536)] = -2.85717e-21	(0 kip-in/(393435.5 in^4)(4833.926 KSI))[(1)(0.484898) - (1)(0.387536)] = 0.00000000	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
9	(0.00 kip/(1434.987 in^2)(4833.926 KSI))[(1)(0.484898) - (1)(0.387536)] = -8.69897e-21	(0 kip-in/(393435.5 in^4)(4833.926 KSI))[(1)(0.484898) - (1)(0.387536)] = 0.00000000	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
10	(17.37 kip/(1434.987 in^2)(4899.048 KSI)) [(1)(0.436954) - (1)(0.324252)] = 2.78493e-07	(321 kip-in/(393435.5 in^4)(4899.048 KSI))[(1)(0.436954) - (1)(0.324252)] = 0.00000002	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
11	(0.00 kip/(1434.987 in^2)(4925.015 KSI))[(1)(0.412647) - (1)(0.261269)] = 0	(0 kip-in/(393435.5 in^4)(4925.015 KSI))[(1)(0.412647) - (1)(0.261269)] = 0.00000000	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
12	(0.00 kip/(1434.987 in^2)(4925.015 KSI))[(1)(0.412647) - (1)(0.261269)] = -6.66889e-50	(0 kip-in/(393435.5 in^4)(4925.015 KSI))[(1)(0.412647) - (1)(0.261269)] = 0.00000000	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
13	(0.00 kip/(1434.987 in^2)(4925.015 KSI))[(1)(0.412647) - (1)(0.261269)] = 0	(0 kip-in/(393435.5 in^4)(4925.015 KSI))[(1)(0.412647) - (1)(0.261269)] = 0.00000000	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
14	(0.64 kip/(1434.987 in^2)(4926.622 KSI))[(1)(0.410953) - (1)(0.254165)] = 1.41609e-08	(12 kip-in/(393435.5 in^4)(4926.622 KSI)) [(1)(0.410953) - (1)(0.254165)] = 0.00000000	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
15	(0.00 kip/(1434.987 in^2)(4928.146 KSI))[(1)(0.409319) - (1)(0.246651)] = 0	(0 kip-in/(393435.5 in^4)(4928.146 KSI))[(1)(0.409319) - (1)(0.246651)] = 0.00000000	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
16	(0.59 kip/(1434.987 in^2)(4929.593 KSI))[(1)(0.407743) - (1)(0.238662)] = 1.40068e-08	(11 kip-in/(393435.5 in^4)(4929.593 KSI)) [(1)(0.407743) - (1)(0.238662)] = 0.00000000	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
17	(0.46 kip/(1434.987 in^2)(4932.095 KSI))[(1)(0.404954) - (1)(0.222311)] = 1.19643e-08	(9 kip-in/(393435.5 in^4)(4932.095 KSI))[(1)(0.404954) - (1)(0.222311)] = 0.00000000	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
18	(0.00 kip/(1434.987 in^2)(4933.175 KSI))[(1)(0.403724) - (1)(0.213967)] = 0	(0 kip-in/(393435.5 in^4)(4933.175 KSI))[(1)(0.403724) - (1)(0.213967)] = 0.00000000	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
19	(0.07 kip/(1434.987 in^2)(4933.351 KSI))[(1)(0.403522) - (1)(0.21252)] = 1.95911e-09	(1 kip-in/(393435.5 in^4)(4933.351 KSI))[(1)(0.403522) - (1)(0.21252)] = 0.00000000	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
20	(-1405.84 kip/(1434.987 in^2)(4933.526 KSI))[(1)(0.403321) - (1)(0.211056)] = -3.81797e-05	(-6172 kip-in/(393435.5 in^4)(4933.526 KSI))[(1)(0.403321) - (1)(0.211056)] = -0.00000061	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
21	(8.83 kip/(1451.874 in^2)(4933.699 KSI))[(1)(0.403121) - (1)(0.209575)] = 2.38482e-07	(48 kip-in/(393871.6 in^4)(4933.699 KSI)) [(1)(0.403121) - (1)(0.209575)] = 0.00000000	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
22	(0.00 kip/(1451.874 in^2)(4933.872 KSI))[(1)(0.402922) - (1)(0.208075)] = -7.74049e-20	(0 kip-in/(393871.6 in^4)(4933.872 KSI))[(1)(0.402922) - (1)(0.208075)] = 0.00000000	(0.00 kip/(0.000 in^2)(0.000 KSI))[(1)(0) - (1)(0)] = 0	(0 kip-in/(0.0 in^4)(0.000 KSI))[(1)(0) - (1)(0)] = 0.00000000
23	(12.36 kip/(1451.874 in^2)(4935.047 KSI)) [(1)(0.401553) - (1)(0.197045)] = 3.529e-07	(113 kip-in/(393871.6 in^4)(4935.047 KSI))[(1)(0.401553) - (1)(0.197045)] = 0.00000001	(0.00 kip/(0.000 in^2)(3774.473 KSI))[(1)(1.19745) - (1)(0.496698)] = 0	(0 kip-in/(0.0 in^4)(3774.473 KSI))[(1)(1.19745) - (1)(0.496698)] = 0.00000000
24	(0.00 kip/(1451.874 in^2)(4936.170 KSI))[(1)(0.400225) - (1)(0.18496)] = 0	(0 kip-in/(393871.6 in^4)(4936.170 KSI))[(1)(0.400225) - (1)(0.18496)] = 0.00000000	(0.00 kip/(1524.880 in^2)(4219.725 KSI))[(1)(0.853048) - (1)(0.350241)] = 0	(0 kip-in/(8125.5 in^4)(4219.725 KSI))[(1)(0.853048) - (1)(0.350241)] = 0.00000000
25	(-24.54 kip/(1451.874 in^2)(4938.271 KSI)) [(1)(0.397684) - (1)(0.15681)] = -8.24534e-07	(1178 kip-in/(393871.6 in^4)(4938.271 KSI))[(1)(0.397684) - (1)(0.15681)] = 0.00000015	(39.85 kip/(1524.880 in^2)(4544.066 KSI)) [(1)(0.655738) - (1)(0.23935)] = 2.39468e-06	(13 kip-in/(8125.5 in^4)(4544.066 KSI)) [(1)(0.655738) - (1)(0.23935)] = 0.00000015
26	(-436.62 kip/(1451.874 in^2)(4940.201 KSI))[(1)(0.395283) - (1)(0.121404)] = -1.66721e-05	(59 kip-in/(393871.6 in^4)(4940.201 KSI)) [(1)(0.395283) - (1)(0.121404)] = 0.00000001	(-440.64 kip/(1524.880 in^2)(4677.317 KSI))[(1)(0.581262) - (1)(0.168111)] = -2.55246e-05	(1 kip-in/(8125.5 in^4)(4677.317 KSI))[(1)(0.581262) - (1)(0.168111)] = 0.00000001
27	(-2.10 kip/(1471.799 in^2)(4940.333 KSI))[(1)(0.395116) - (1)(0.118513)] = -7.9905e-08	(164 kip-in/(397941.6 in^4)(4940.333 KSI))[(1)(0.395116) - (1)(0.118513)] = 0.00000002	(8.40 kip/(1524.880 in^2)(4683.907 KSI))[(1)(0.577585) - (1)(0.163271)] = 4.87201e-07	(3 kip-in/(8125.5 in^4)(4683.907 KSI))[(1)(0.577585) - (1)(0.163271)] = 0.00000003
28	(0.00 kip/(1471.799 in^2)(4940.464 KSI))[(1)(0.39495) - (1)(0.115566)] = 8.5359e-20	(0 kip-in/(397941.6 in^4)(4940.464 KSI))[(1)(0.39495) - (1)(0.115566)] = 0.00000000	(0.00 kip/(1524.880 in^2)(4690.233 KSI))[(1)(0.574052) - (1)(0.158425)] =	(0 kip-in/(8125.5 in^4)(4690.233 KSI))[(1)(0.574052) - (1)(0.158425)] =

Loading Interval	Girder		Deck	
	Δε	Δφ (in^{-1})	Δε	Δφ (in^{-1})
			-1.42107e-19	0.00000000
29	(-44.18 kip/(1471.799 in^2)(4942.222 KSI)) [(1)(0.392693) - (1)(0.0672216)] = -1.97699e-06	(1766 kip-in/(397941.6 in^4)(4942.222 KSI))[(1)(0.392693) - (1)(0.0672216)] = 0.00000029	(68.10 kip/(1524.880 in^2)(4757.992 KSI)) [(1)(0.535715) - (1)(0.0871477)] = 4.21039e-06	(29 kip-in/(8125.5 in^4)(4757.992 KSI)) [(1)(0.535715) - (1)(0.0871477)] = 0.00000033
30	(0.00 kip/(1471.799 in^2)(4943.848 KSI))[(1)(0.390549) - (1)(0)] = 0	(0 kip-in/(397941.6 in^4)(4943.848 KSI))[(1)(0.390549) - (1)(0)] = 0.00000000	(0.00 kip/(1524.880 in^2)(4801.403 KSI))[(1)(0.510215) - (1)(0)] = 0	(0 kip-in/(8125.5 in^4)(4801.403 KSI))[(1)(0.510215) - (1)(0)] = 0.00000000
Total	-5.64436e-05	-0.00000008	-1.84323e-05	0.00000052

Unrestrained shrinkage deformation of concrete components

Girder: $\Delta\varepsilon_{sh}$ = -4.0406e-05

Deck: $\Delta\varepsilon_{sh}$ = -0.000175661

Apparent unrestrained deformation of strands due to relaxation

$$\Delta\varepsilon_r = -\frac{\Delta f_r(i_e, i_b)}{E_{ps}}$$

Strand	Δf_r (KSI)	$\Delta\varepsilon_r$
Straight	0.000	0
Harped	-0.927	3.25352e-05
Temporary	0.000	0

Apparent unrestrained deformation of tendons due to relaxation

$$\Delta\varepsilon_r = -\frac{\Delta f_r(i_e, i_b)}{E_{ps}}$$

Tendon	Δf_r (KSI)	$\Delta\varepsilon_r$
1	-1.194	4.1879e-05
2	-1.194	4.1879e-05
3	-1.428	5.01033e-05
4	-1.428	5.01033e-05

Component Restraining Forces

$$\Delta P_r = -(\Delta\varepsilon)(EA)$$

$$\Delta M_r = -(\Delta\varphi)(EI)$$

Component	Creep		Shrinkage		Relaxation	
	ΔP_r (kip)	ΔM_r (kip-in)	ΔP_r (kip)	ΔM_r (kip-in)	ΔP_r (kip)	ΔM_r (kip-in)
Girder	-(-5.64436e-05)(4981.404 KSI)(1471.799 in^2) = 413.82 kip	-(-0.00000008 in^{-1})(4981.404 KSI)(397941.6 in^4) = 155 kip-in	-(-4.0406e-05)(4981.404 KSI)(1471.799 in^2) = 296.24 kip			
Deck	-(-1.84323e-05)(4995.671 KSI)(1524.880 in^2) = 140.41 kip	-(0.00000052 in^{-1})(4995.671 KSI)(8125.5 in^4) = -21 kip-in	-(-0.000175661)(4995.671 KSI)(1524.880 in^2) = 1338.15 kip			
Straight Strands					-(0)(0.000 KSI)(0.000 in^2) = 0.00 kip	
Harped Strands					-(3.25352e-05)(28500.000 KSI)(4.340 in^2) = -4.02 kip	
Temporary Strands					-(0)(0.000 KSI)(0.000 in^2) = 0.00 kip	
Tendon 1					-(4.1879e-05)(28500.000 KSI)(4.123 in^2) = -4.92 kip	
Tendon 2					-(4.1879e-05)(28500.000 KSI)(4.123 in^2) = -4.92 kip	
Tendon 3					-(5.01033e-05)(28500.000 KSI)(2.604 in^2) = -3.72 kip	
Tendon 4					-(5.01033e-05)(28500.000 KSI)(2.604 in^2) = -3.72 kip	

Section Restraining Forces

$$P_r = \sum \Delta P_r$$

$$M_r = \sum\left(\Delta M_r + \Delta P_r(Y_{tr} - Y)\right)$$

Component	Creep		Shrinkage		Relaxation	
	P_r (kip)	M_r (kip-in)	P_r (kip)	M_r (kip-in)	P_r (kip)	M_r (kip-in)
Composite Section	554.24	3845	1634.39	-16450	-21.30	-319

Section Restraining Deformations

$$\varepsilon_r = \frac{P_r}{E_{tr}A_{tr}}$$

$$\varphi_r = \frac{M_r}{E_{tr}I_{tr}}$$

Component	Creep		Shrinkage		Relaxation	
	ε_r	φ_r (in^{-1})	ε_r	φ_r (in^{-1})	ε_r	φ_r (in^{-1})
Composite Section	4.50095e-05	0.00000086	0.000132729	-0.00000366	-1.73001e-06	-0.00000007

Section restraining deformations are computed at multiple sections along the girder. It is assumed that deformations vary linerally between sections. The girder is analyzed for these deformations. The resulting section forces are listed in the Restrained Section Forces table below.

Restrained Section Forces

Component	Creep		Shrinkage		Relaxation	
	$\overline{P}_r$ (kip)	$\overline{M}_r$ (kip-in)	$\overline{P}_r$ (kip)	$\overline{M}_r$ (kip-in)	$\overline{P}_r$ (kip)	$\overline{M}_r$ (kip-in)
Composite Section	0.00	0	0.00	0	0.00	0

The restrained section forces are the secondary forces due to the structural system restraining the deformations due to creep, shrinkage, and relaxation.

Restrained Component Forces

$$\overline{\Delta P}_r = \left[\frac{(\overline{P}_r - P_r)}{E_{tr}A_{tr}} + \frac{(\overline{M}_r - M_r)(Y_{tr} - Y_k)}{E_{tr}I_{tr}}\right]E_kA_k + \Delta P_r$$

$$\overline{\Delta M}_r = (\overline{M}_r - M_r)\left(\frac{E_kI_k}{E_{tr}I_{tr}}\right) + \Delta M_r$$

Component	Creep		Shrinkage		Relaxation	
	$\overline{\Delta P}_r$ (kip)	$\overline{\Delta M}_r$ (kip-in)	$\overline{\Delta P}_r$ (kip)	$\overline{\Delta M}_r$ (kip-in)	$\overline{\Delta P}_r$ (kip)	$\overline{\Delta M}_r$ (kip-in)
Girder	88.35	-1162	-163.62	5632	15.60	109
Girder Rebar 1	-0.42		-0.10		0.02	
Girder Rebar 2	-0.42		-0.10		0.02	
Girder Rebar 3	-0.42		-0.10		0.02	
Girder Rebar 4	-0.42		-0.10		0.02	
Girder Rebar 5	-0.42		-0.10		0.02	
Girder Rebar 6	-0.95		-0.07		0.05	
Girder Rebar 7	-0.95		-0.07		0.05	
Girder Rebar 8	-0.95		-0.07		0.05	
Girder Rebar 9	-0.95		-0.07		0.05	
Girder Rebar 10	-0.95		-0.07		0.05	
Girder Rebar 11	-0.95		-0.07		0.05	
Straight Strands	0.00		0.00		0.00	
Harped Strands	-8.96		-1.91		-3.53	
Temporary Strands	0.00		0.00		0.00	
Deck	-47.70	-48	219.22	115	3.75	2
Deck Top Mat Individual Rebar	-2.73		-18.49		0.04	
Deck Top Mat Lump Sum Rebar	0.00		0.00		0.00	
Deck Bottom Mat Individual Rebar	0.00		0.00		0.00	
Deck Bottom Mat Lump Sum Rebar	0.00		0.00		0.00	
Tendon 1	-7.23		-7.30		-4.56	
Tendon 2	-7.23		-7.30		-4.56	
Tendon 3	-3.34		-9.84		-3.59	
Tendon 4	-3.34		-9.84		-3.59	

Incremental forces due to external loads and restrained component forces during this interval.

$$\Delta P_k = \left[\frac{\Delta P}{A_{tr}E_{tr}} + \frac{\Delta M(Y_{tr} - Y_k)}{I_{tr}E_{tr}}\right]A_kE_k$$

$$\Delta M_k = \Delta M\frac{I_kE_k}{I_{tr}E_{tr}}$$

Component		Loading														Incremental Total	Cumulative Total
		Girder	Diaphragm	Slab	Haunch	Slab Panel	Sidewalk	Railing System	Overlay	Pre-tensioning	Post-tensioning	Secondary Effects	Creep	Shrinkage	Relaxation		

Component		Loading														Incremental Total	Cumulative Total
		Girder	Diaphragm	Slab	Haunch	Slab Panel	Sidewalk	Railing System	Overlay	Pre-tensioning	Post-tensioning	Secondary Effects	Creep	Shrinkage	Relaxation		
Composite	ΔP (kip) ΔM (kip-in)	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	-2376.00 -6248
Girder	ΔP_k (kip) ΔM_k (kip-in)	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	88.35 -1162	-163.62 5632	15.60 109	-59.68 4580	-1907.12 2561
Girder Rebar 1	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.42	-0.10	0.02	-0.49	-3.62
Girder Rebar 2	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.42	-0.10	0.02	-0.49	-3.62
Girder Rebar 3	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.42	-0.10	0.02	-0.49	-3.62
Girder Rebar 4	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.42	-0.10	0.02	-0.49	-3.62
Girder Rebar 5	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.42	-0.10	0.02	-0.49	-3.62
Girder Rebar 6	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.95	-0.07	0.05	-0.97	-7.90
Girder Rebar 7	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.95	-0.07	0.05	-0.97	-7.90
Girder Rebar 8	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.95	-0.07	0.05	-0.97	-7.90
Girder Rebar 9	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.95	-0.07	0.05	-0.97	-7.90
Girder Rebar 10	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.95	-0.07	0.05	-0.97	-7.90
Girder Rebar 11	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.95	-0.07	0.05	-0.97	-7.90
Straight Strands	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Harped Strands	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-8.96	-1.91	-3.53	-14.40	756.54
Temporary Strands	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Deck	ΔP_k (kip) ΔM_k (kip-in)	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	0.00 0	-47.70 -48	219.22 115	3.75 2	175.26 69	-149.03 115
Deck Top Mat Individual Rebar	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-2.73	-18.49	0.04	-21.19	-35.93
Deck Top Mat Lump Sum Rebar	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Deck Bottom Mat Individual Rebar	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Deck Bottom Mat Lump Sum Rebar	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tendon 1	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-7.23	-7.30	-4.56	-19.08	690.41
Tendon 2	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-7.23	-7.30	-4.56	-19.08	690.41
Tendon 3	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-3.34	-9.84	-3.59	-16.77	431.28
Tendon 4	ΔP_k (kip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-3.34	-9.84	-3.59	-16.77	431.28

Incremental component stress

$$\Delta f_k(top) = \frac{\Delta P_k}{A_k} + \frac{\Delta M_k Y_k}{I_k} \quad \Delta f_k(bottom) = \frac{\Delta P_k}{A_k} + \frac{\Delta M_k (H + Y_k)}{I_k} \quad \Delta f_k(strand/tendon) = \frac{\Delta P_k}{A_k}$$

Component	Loading														Incremental Total (KSI)	Cumulative Total (KSI)
	Girder (KSI)	Diaphragm (KSI)	Slab (KSI)	Haunch (KSI)	Slab Panel (KSI)	Sidewalk (KSI)	Railing System (KSI)	Overlay (KSI)	Pre-tensioning (KSI)	Post-tensioning (KSI)	Secondary Effects (KSI)	Creep (KSI)	Shrinkage (KSI)	Relaxation (KSI)		
Top Girder	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.135	-0.474	0.004	-0.336	-1.484
Bottom Girder	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.005	0.205	0.017	0.217	-1.181
Straight Strands	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Harped Strands	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-2.064	-0.441	-0.813	-3.318	174.318
Temporary Strands	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Top Deck	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.008	0.087	0.001	0.081	-0.154
Bottom Deck	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.055	0.200	0.004	0.149	-0.041
Tendon 1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-1.753	-1.770	-1.105	-4.628	167.453
Tendon 2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-1.753	-1.770	-1.105	-4.628	167.453
Tendon 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-1.284	-3.777	-1.379	-6.440	165.623
Tendon 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-1.284	-3.777	-1.379	-6.440	165.623

Change in stress in strands and tendons are the prestress losses during this interval.

Creep Details

Creep coefficient details

$$\psi(t,t_i) = 1.9k_{vs}k_{hc}k_f k_{td} t_i^{-0.118}$$

$$k_{vs} = 1.45 - 0.13\left(\frac{V}{S}\right) \geq 1.0$$

$$k_{hc} = 1.56 - 0.008H$$

$$k_f = \frac{5}{1 + f'_{ci}}$$

$$k_{td} = \frac{t}{12\left(\frac{100 - 4f'_{ci}}{f'_{ci} + 20}\right) + t}$$

t_b = age of concrete at beginning of interval
t_e = age of concrete at end of interval
t_i = age of concrete at the middle of loading interval
H = 75 %

Girder

V/S = 3.934 in

Interval	t_b (day)	t_e (day)	Loading Interval	t_i (day)	f'_{ci} (KSI)	k_{vs}	k_{hc}	k_f	$k_{td}(t_b - t_i)$	$k_{td}(t_e - t_i)$	$\psi(t_b - t_i,t_i)$	$\psi(t_e - t_i,t_i)$

Deck

V/S = 4.794 in

Interval	t_b (day)	t_e (day)	Loading Interval	t_i (day)	f'_{ci} (KSI)	k_{vs}	k_{hc}	k_f	$k_{td}(t_b - t_i)$	$k_{td}(t_e - t_i)$	$\psi(t_b - t_i,t_i)$	$\psi(t_e - t_i,t_i)$

Shrinkage Details

Concrete shrinkage details

$$\Delta\varepsilon_{sh} = \varepsilon_{sh}(t_e) - \varepsilon_{sh}(t_b)$$

$$\varepsilon_{sh} = -k_{vs}k_{hs}k_f k_{td} 0.48 \times 10^{-3}$$

$$k_{vs} = 1.45 - 0.13\left(\frac{V}{S}\right) \geq 0.10$$

$$k_{hs} = (2.0 - 0.014H)$$

$$k_f = \frac{5}{1 + f'_{ci}}$$

$$k_{td} = \frac{t}{12\left(\frac{100 - 4f'_{ci}}{f'_{ci} + 20}\right) + t}$$

t_b = Duration of shrinkage to the beginning of the interval
t_e = Duration of shrinkage to the end of the interval
H = 75 %

Girder

V/S = 3.934 in
f'_{ci} = 4.882 KSI

Interval	t_b (day)	t_e (day)	k_{vs}	k_{hs}	k_f	$k_{td}(t_b)$	$k_{td}(t_e)$	$\varepsilon_{sh}(t_b)\text{x}10^6$	$\varepsilon_{sh}(t_e)\text{x}10^6$	$\Delta\varepsilon_{sh}\text{x}10^6$
31	169	3629	1	0.95	0.862069	0.812122	0.989341	-185.164	-225.57	-40.406

Deck

V/S = 4.794 in
f'_{ci} = 3.869 KSI

Interval	t_b (day)	t_e (day)	k_{vs}	k_{hs}	k_f	$k_{td}(t_b)$	$k_{td}(t_e)$	$\varepsilon_{sh}(t_b)\text{x}10^6$	$\varepsilon_{sh}(t_e)\text{x}10^6$	$\Delta\varepsilon_{sh}\text{x}10^6$
31	22	3482	1	0.95	1.02683	0.341124	0.987944	-92.6413	-268.302	-175.661

Relaxation Details

Strand relaxation details

$$\Delta f_{pR} = 0.0222 f_{pe}\left(\frac{f_{pe}}{f_{py}} - 0.55\right)\left[\log(24(t_e)) - \log(24(t_b))\right]$$

t_b = time from stressing to the beginning of the interval
t_e = time from stressing to the end of the interval

Interval	Strand	f_{pe} (KSI)	f_{py} (KSI)	t_b (day)	t_e (day)	Epoxy Factor	Δf_r (KSI)
31	Straight	0.000	0.000	0	0	0	0.000
	Harped	177.636	243.000	183	3643	1	-0.927
	Temporary	0.000	0.000	0	0	0	0.000

Tendon relaxation details

$$\Delta f_{pR} = 0.0222 f_{pe}\left(\frac{f_{pe}}{f_{py}} - 0.55\right)\left[\log(24(t_e)) - \log(24(t_b))\right]$$

t_b = time from stressing to the beginning of the interval
t_e = time from stressing to the end of the interval

Interval	Tendon	f_{pe} (KSI)	f_{py} (KSI)	t_b (day)	t_e (day)	Epoxy Factor	Δf_r (KSI)
31	1	172.081	243.000	37	3497	1	-1.194
	2	172.081	243.000	37	3497	1	-1.194
	3	172.062	243.000	15	3475	1	-1.428
	4	172.062	243.000	15	3475	1	-1.428