HNTB	The HNTB Companies Engineers Architects Planners	Made	SJL	Date	6/20/2013	Job Number	49633
		Checked	VWR	Date	6/21/2013		
For	Cleveland Innerbelt	Backchk'd	SJL	Date	6/21/2013	Sheet No.	

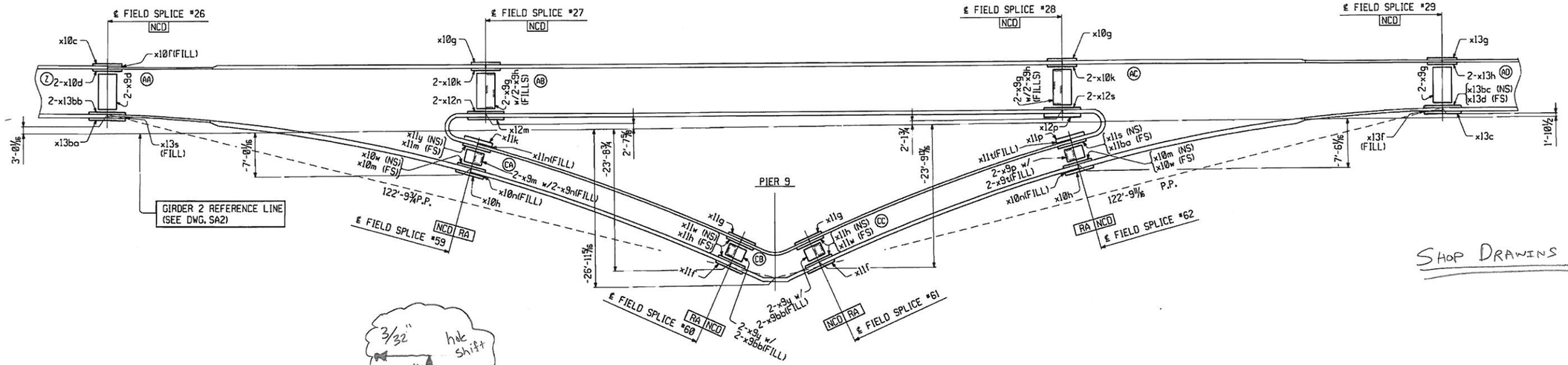
Unit 2 - Structural Steel, RFI 457

Girder 2, FS 31 and Girder 2 FS 66 (below FS 32) web splices have holes that conflict and need to be reamed to achieve fit-up in the field.

Walsh proposes to ream the conflicting holes to a 1.3125" dia. hole and use a 1.25" dia. bolt.

Calculations were performed to check the splices. Included in the calculations was the check for Bolt Bearing (AASHTO 6.13.2.9) with the reduced distance between holes and reduced end distances taken into account. Both Girder 2, FS 31 and Girder 2, FS 66 were found to be OK for design checks.

Reaming the conflicting holes to a 1.3125" dia. hole and using a 1.25" dia. bolt will violate the AASHTO minimum bolt spacing. This issue was discussed at the 4-19-13 meeting between ODOT, HDR, Walsh and HNTB.



DELTA LEG ASSEMBLY DIAGRAM - GIRDER LINE 2 (PIER 9)

SHOP DRAWINS

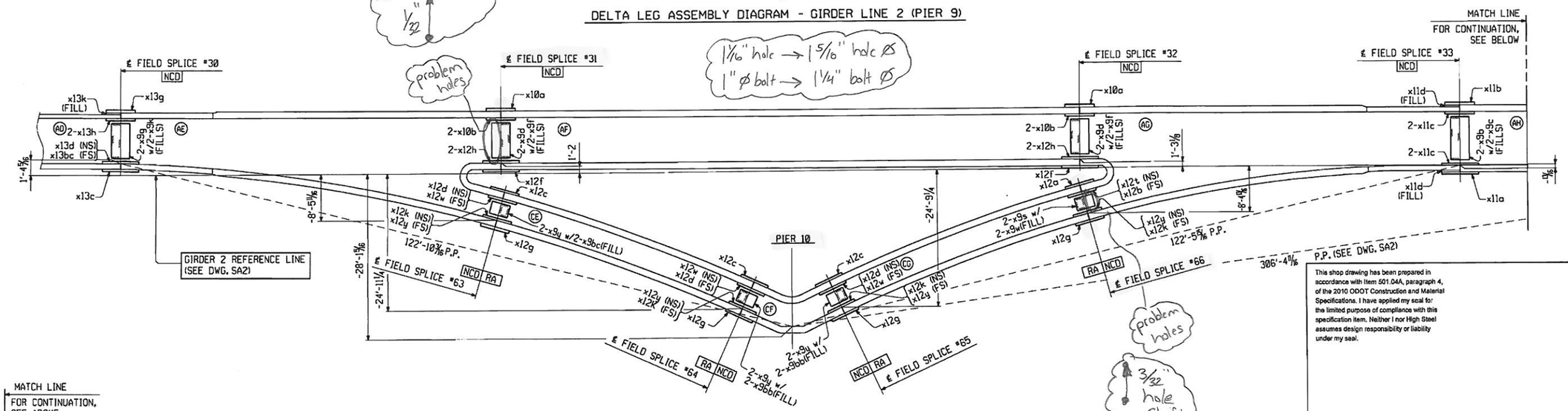
3/32" hole shift

1/32"

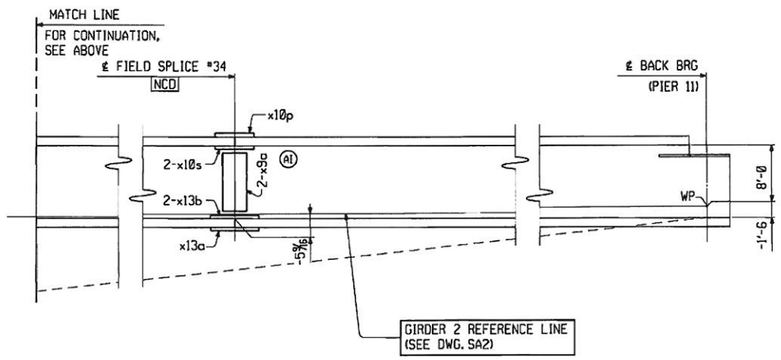
problem holes

1⅛" hole → 1 5/16" hole Ø

1" Ø bolt → 1¼" bolt Ø



DELTA LEG ASSEMBLY DIAGRAM - GIRDER LINE 2 (PIER 10)



PL's @ F.S. No.	SHIPPED w/ GIRD.
#26	G2Z
#27	G2AB
#28	
#29	G2AD
#30	
#31	G2AF
#32	
#33	G2AH
#34	G2AI

PL's @ F.S. No.	SHIPPED w/ GIRD.
#59	G2CA
#60	
#61	G2CC
#62	
#63	G2CE
#64	
#65	G2CG
#66	

SHOP NOTE
- FOR SWEEP DIAGRAM OF DELTA LEGS, SEE DWG. SA27
- FOR CAMBER & SWEEP DIAGRAM OF ROADWAY GIRDERS, SEE DWG. SA29

FOR NOTES, SEE DWG. SA1.
WORK THIS DWG. WITH DWG. SA2, SA27, SA29.
NEGATIVE (-) DIMENSION INDICATES BOTTOM OF WEB IS BELOW REFERENCE LINE.
P.P. DIMENSIONS ARE ALONG ℄ WEB AND ARE FOR DESIGN CHECK, NOT YARD FIT-UP CHECK.

This shop drawing has been prepared in accordance with Item 501.04A, paragraph 4, of the 2010 ODOT Construction and Material Specifications. I have applied my seal for the limited purpose of compliance with this specification item. Neither I nor High Steel assumes design responsibility or liability under my seal.

NO.	REVISION	BY	CHK'D	DATE

HOLES
BOLTS
COATING
CODE(S)
SCALE N.T.S.

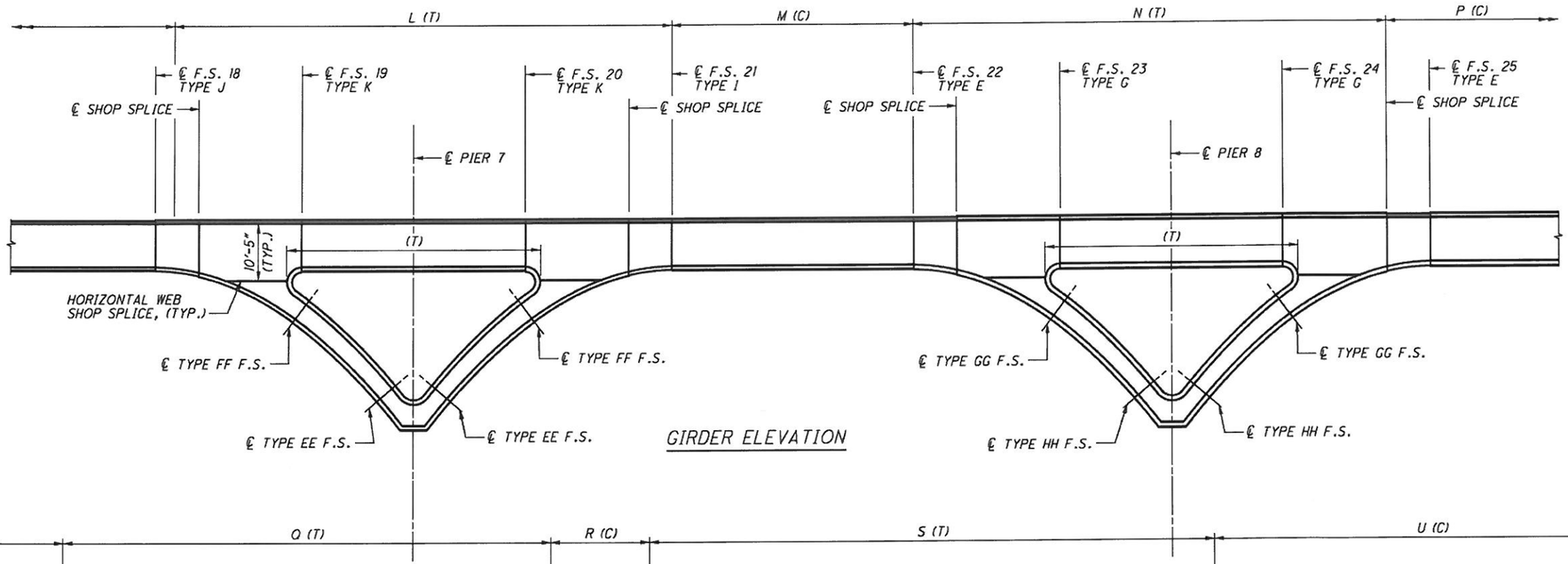
HIGH STEEL STRUCTURES, LLC
An ISO 9001:2000 Certified Company
An Affiliate of High Industries, Inc.
Lancaster Facility: 1915 Old Philadelphia Pike, Lancaster, PA 17605-0008, Phone (717) 299-5211
Williamsport Facility: 3501 W. 4th Street, Williamsport, PA 17701, Phone (570) 326-9051, www.highsteel.com

SHOP ASSEMBLY DIAGRAM - GIRDER LINE 2
CLEVELAND INNERBELT BRIDGE
I-90 (WB) - MAIN SPAN - UNIT 2 (SPANS 3 THRU 11)
BRIDGE NO. CUY-90-1532 PID NO. 77332/85531
CITY OF CLEVELAND - CUYAHOGA COUNTY, OHIO
OHIO DEPARTMENT OF TRANSPORTATION

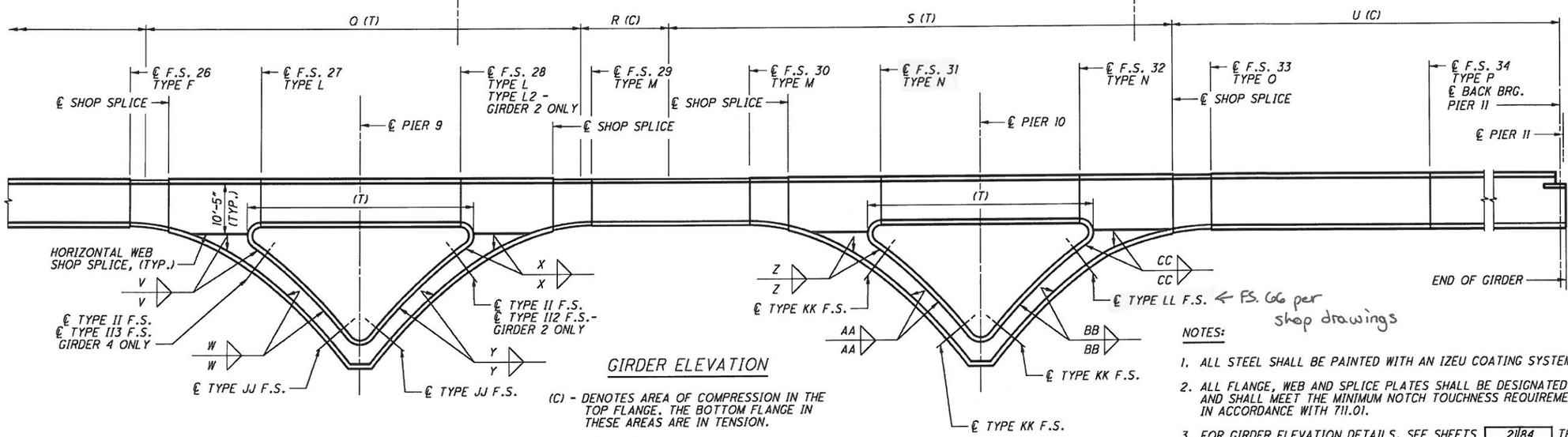
STATE CONT. OR REF. NO.	CUY-90-14.90	FED. AID PROJ. NO.	E090 (546); E100 (247)
GENERAL CONTRACTOR	WALSH CONSTRUCTION	HSSI PROJ. MGR	KEN GLIDDEN
DRAWING MANAGER	D. PAINTER (WDI-1029)	MADE BY	GTK
CHK'D. BY	GS/GLT	DATE	9/30/11
HSSI PROJECT NUMBER	S-1100163C-5	DRAWING NUMBER	SA28 OF

OH

$DATE$
$TIME$
$FILEABBREV$



GIRDER ELEVATION



GIRDER ELEVATION

(C) - DENOTES AREA OF COMPRESSION IN THE TOP FLANGE. THE BOTTOM FLANGE IN THESE AREAS ARE IN TENSION.

(T) - DENOTES AREA OF TENSION IN THE TOP FLANGE. THE BOTTOM FLANGE IN THESE AREAS ARE IN COMPRESSION, UNLESS NOTED OTHERWISE.

DIMENSION	GIRDER 1	GIRDER 2	GIRDER 3	GIRDER 4	GIRDER 5
L	230'-3"	230'-3"	230'-3"	230'-3"	230'-3"
M	111'-11 3/8"	111'-9 5/16"	111'-7 1/4"	119'-8 5/16"	111'-3 1/2"
N	238'-6"	238'-5 15/16"	238'-6"	230'-2 7/16"	238'-6"
P	114'-11"	118'-10 1/4"	116'-5 1/4"	108'-8 11/16"	107'-2 3/8"
O	235'-4 5/16"	223'-9 3/16"	218'-6"	218'-6"	223'-8 15/16"
R	96'-9 7/8"	89'-0 3/16"	90'-2 3/8"	74'-3 13/16"	44'-8 3/8"
S	238'-9 7/8"	241'-10"	234'-8 13/16"	238'-4 1/4"	243'-2 9/16"
U	206'-5 15/16"	201'-11 7/8"	198'-6 5/16"	201'-6 1/8"	205'-6 1/16"

WELD SIZES *					
	GIRDER 1	GIRDER 2	GIRDER 3	GIRDER 4	GIRDER 5
V	---	3/8	9/16 (1/2)	---	---
W	---	---	---	---	---
X	---	---	3/8	3/8	---
Y	---	3/8	---	---	---
Z	---	3/8	3/8	3/8	---
AA	---	3/8	---	---	---
BB	---	1/16 (3/8)	3/8	3/8	---
CC	3/8	3/8	1/16 (3/8)	---	3/8

* F_{exx} 70 ksi WELD SIZE LISTED FIRST.
F_{exx} 80 ksi WELD SIZE LISTED SECOND IN PARENTHESIS.

NOTES:

1. ALL STEEL SHALL BE PAINTED WITH AN IZEU COATING SYSTEM.
2. ALL FLANGE, WEB AND SPLICE PLATES SHALL BE DESIGNATED "CVN" AND SHALL MEET THE MINIMUM NOTCH TOUCHNESS REQUIREMENTS IN ACCORDANCE WITH 711.01.
3. FOR GIRDER ELEVATION DETAILS, SEE SHEETS 21|84 THRU 24|84.
4. FOR FIELD SPLICE DETAILS, SEE SHEETS 29|84 AND 30|84.
5. BOTH TOP AND BOTTOM FLANGES OF ALL DELTA FRAME LEGS ARE COMPRESSION FLANGES FOR DEAD LOAD.
6. WELD ATTACHMENT OF SUPPORT FOR CONCRETE DECK FINISHING MACHINE TO AREAS OF THE FASCIA GIRDER FLANGES DESIGNATED "COMPRESSION". DO NOT WELD ATTACHMENTS TO AREAS DESIGNATED "TENSION". FILLET WELDS TO COMPRESSION FLANGES SHALL BE AT LEAST 1" FROM EDGE OF FLANGE, BE NO MORE THAN 2" LONG AND BE AT LEAST 1/4" FOR THICKNESS UP TO 3/4" OR 5/16" FOR GREATER THAN 3/4" THICK.
7. ALL WEB TO FLANGE WELD SIZES SHALL BE 5/16" UNLESS NOTED OTHERWISE.
8. FOR GIRDER DELTA FRAME GEOMETRY, SEE SHEET 25|84.
9. FOR ADDITIONAL FLANGE TO WEB WELD DETAILS ADJACENT TO THE RADIAL STIFFENERS, SEE SHEET 41|84.

NO.	REVISIONS	DATE
B	FINAL SUBMITTAL	04/14/11
C	FINAL SUBMITTAL - REVISED	06/09/11
D	FINAL SUBMITTAL - REVISED	08/09/11
1	APPROVED FOR CONSTRUCTION	09/21/11

DESIGN AGENCY WILSH HNTB WILSH CONSTRUCTION

CLEVELAND'S INNERBELT BRIDGE

MAIN SPAN UNIT 2 STRUCTURAL STEEL

SUPPLEMENTAL GIRDER ELEVATIONS

BRIDGE NO. CUY-90-1532
I-90 WEST BOUND

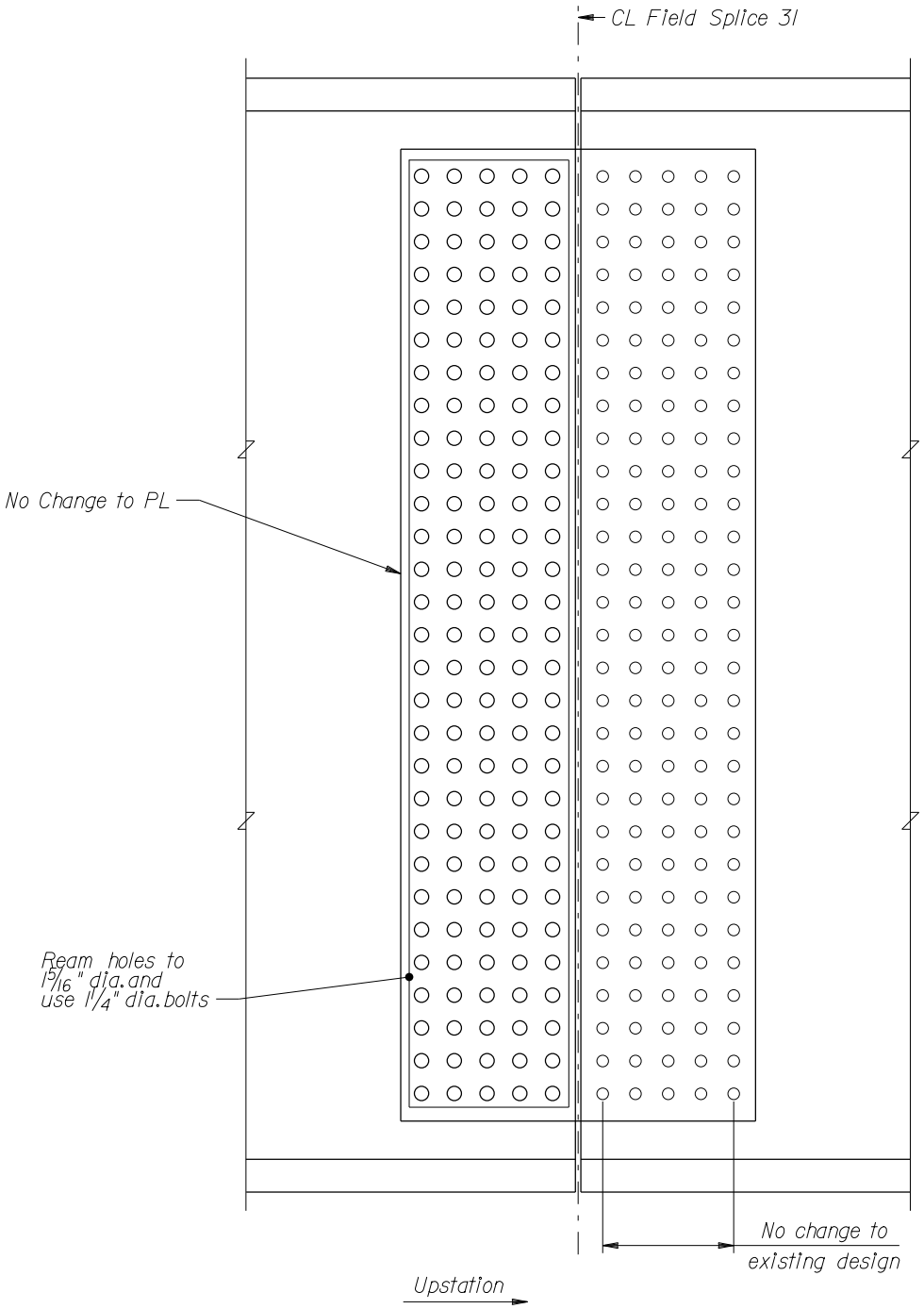
DESIGNED	DRAWN	REVIEWED	DATE
SAE	FWG	HRH	09/21/11
CHECKED	CHECKED	STRUCTURE FILE NUMBER	
MCC	LJD	1809431	

CUY-90-14.90
PID No. 77332/85531

32/84

Date: 1/17/2013
Model: Sheet1
File: 49633-S-BR-FSD08-U2StSteel.dgn

PROJECT	MADE	DATE	
Cleveland Innerbelt	VWR	06-19-13	HNTB
STRUCTURE	CHECKED	DATE	
I-90 WB - Unit 2	SJL	06-21-13	
FOR	BACK CHECKED	DATE	PROJECT NUMBER
RFI 457 - FS 31, Girder 2	VWR	06-21-13	49633



Notes:
1. Flange splice not shown for clarity.
2. All material and workmanship shall be in accordance with the RFC plans.
3. The center of the reamed holes shall be shifted vertically 1/32" (up) and 3/32" horizontally (backstation) to allow conflicting material to be removed.
4. Bolts shall be high strength A325 galvanized Type 1 bolts.
5. Final reamed holes through splice plates and web shall be circular and concentric.

HNTB The HNTB Companies Engineers Architects Planners	Made	SAE	Date	8/5/2011	Job Number	49633	Revised	DJG	Date	10/3/2012
	Checked	WME	Date	8/5/2011			Checked	SJL	Date	10/11/2012
For Cleveland InnerBelt : Field Splice - Node 3281	Backchk'd	SAE	Date	8/5/2011	Sheet No.		Backchk'd	DJG	Date	10/11/2011

N:\49633\Bridges\Design\Final Design\Unit 2\NDC65_MODEL\RFIs\[Field Splice_2013-06-19.xlsm]Type N

Field Splice - Node 3281

Initials for all pages of worksheet "Type N" for Node 3281.	Revised	VWR	Date	6/19/2013
	Checked	SJL	Date	6/20/2013
	Backchk'd	VWR	Date	6/21/2013

Node 3281

Resisance Factors (6.5.4.2)

ϕf	1.00
ϕv	1.00
ϕc	0.90
ϕu	0.80
ϕy	0.95
ϕbb	0.80
ϕs	0.80
ϕbs	0.80
ϕvu	0.80

A325 Bolt

Dia. (in)	1.00
A (in2)	0.79
Fub (ksi)	120
Hole (in)	1.3125

(6.13.2.4.2-1)

	No. Bolt
TF	168
Web	145
BF	132

Notes:

For RFI 457, the web splice and pertinent web splice input was updated. In the field, 1.25 in. dia. bolts will be used in half the web splice where holes will be reamed to 1.3125 in. dia. With a 1.25 in. bolt, Fub is reduced from 120 ksi to 105 ksi (13% reduction), the area of the bolt is increased by 56%. Therefore using 1 in. dia. bolts and 1.3125 in. holes in this worksheet for both the flanges and web will be conservative. Flange splices were not re-evaluated.

For RFI 457, all holes on one side of the web are shifted a constant dimension. Values computed in the geometry worksheet won't change relative to the origin (i.e. lower left bolt in pattern). Therefore the computed centroid of bolt group is adjusted below.

Determine Controlling Section

Section	Top Flange Area	Top Flange ϕf Fnc	Top Flange A*Fnc	Bottom Flange Area	Bottom Flange ϕf Fnc	Bottom Flange A*Fnc	Web Area	Web Fyw	Web A*Fyw
3281 L	144.00	68.63	9883.19	144.00	67.75	9755.74	144.00	50.00	7200.00
3281 R	135.00	68.95	9308.28	135.00	67.95	9173.12	96.00	50.00	4800.00

Rh = 0.99

Controlling Section = 3281 R

Section and Material Properties

		b (in)	t (in)	L (in)	Ag (in2)	An (in2)	Ae (in2)	Fy (ksi)	Fu (ksi)
Girder Section	TF	45.00	3.00	---	135.00	87.75	89.73	70	85
	Web	96.00	1.00	---	96.00	57.94	---	50	65
	BF	45.00	3.00	---	135.00	87.75	89.73	70	85
Splice Plates	TF Outside	45.00	1.625	86.50	73.13	47.53	---	70	85
	TF Inside	21.00	1.750	86.50	73.50	45.94	---	70	85
	BF Inside	21.00	1.375	68.50	57.75	36.09	---	70	85
	BF Outside	45.00	1.250	68.50	56.25	36.56	---	70	85
	Web	89.00	0.875	32.50	155.75	89.14	---	50	65

HNTB	The HNTB Companies Engineers Architects Planners	Made	SAE	Date	8/5/2011	Job Number	49633	Revised	DJG	Date	10/3/2012
		Checked	WME	Date	8/5/2011			Checked	SJL	Date	10/11/2012
For	Cleveland InnerBelt : Field Splice - Node 3281	Backchk'd	SAE	Date	8/5/2011	Sheet No.		Backchk'd	DJG	Date	10/11/2011

Flange Design Forces Strength I-V (6.13.6.1.4c)

	MAX FX		MIN FX		MAX FY		MIN FY		MAX MY		MIN MY		MAX MZ		MIN MZ	
	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF
f (ksi)	29.69	-1.73	39.92	1.50	37.38	-3.63	30.36	7.94	39.41	-4.16	37.09	-3.35	42.21	-6.64	26.01	7.60
ϕf Fnc (ksi)	68.95	67.95	68.95	68.95	68.95	67.91	68.95	68.95	68.95	67.91	68.95	67.92	68.95	67.87	68.95	68.95
f / ϕf Fnc	0.43	0.03	0.58	0.02	0.54	0.05	0.44	0.12	0.57	0.06	0.54	0.05	0.61	0.10	0.38	0.11
α	0.99	0.97	0.99	0.99	0.99	0.97	0.99	0.99	0.99	0.97	0.99	0.97	0.99	0.97	0.99	0.99
fcf (ksi)	29.69		39.92		37.38		30.36		39.41		37.09		42.21		26.01	
Fcf (ksi)	51.71		54.74		53.45		51.71		54.48		53.30		55.90		51.71	
Fcf (kip)	4640.14		4911.85		4795.99		4640.14		4888.58		4782.65		5015.82		4640.14	
fncf (ksi)		-1.73		1.50		-3.63		7.94		-4.16		-3.35		-6.64		7.60
Rcf		1.74		1.37		1.43		1.70		1.38		1.44		1.32		1.99
Fncf (ksi)		-50.96		51.71		-50.94		51.71		-50.93		-50.94		-50.90		51.71
Fncf (kip)		-6879.84		4640.14		-6876.34		4640.14		-6875.62		-6876.92		-6871.42		4640.14

Flange Design Forces - Service II (6.13.6.1.4c)

	MAX FX		MIN FX		MAX FY		MIN FY		MAX MY		MIN MY		MAX MZ		MIN MZ	
	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF
f (ksi)	21.50	-1.33	26.90	-1.75	25.20	-2.90	22.70	4.73	27.27	-3.51	25.57	-2.81	30.99	-4.83	20.47	4.61
Fs (ksi)	21.50	-1.33	26.90	-1.75	25.20	-2.90	22.70	4.73	27.27	-3.51	25.57	-2.81	30.99	-4.83	20.47	4.61
Fs (kip)	2902.20	-179.03	3632.11	-236.19	3402.14	-391.08	3064.65	639.07	3680.93	-474.38	3451.72	-378.83	4183.73	-651.56	2763.74	622.27

Max Flange Design Forces

	Strength I		Service II	
Pu	TF	BF	TF	BF
Tension	5015.82	4640.14	4183.73	639.07
Comp	0.00	6879.84	0.00	651.56

ϕvVn (kip) = 1375.39

e_v (in) = 8.344 Note: 3/32" eccentricity added due to shifted bolt group.

e_h (in) = 0.031 Note: 1/32" eccentricity added due to shifted bolt group.

Web Design Forces (6.13.6.1.4b)

	Strength I								Service II							
	MAX FX	MIN FX	MAX FY	MIN FY	MAX MY	MIN MY	MAX MZ	MIN MZ	MAX FX	MIN FX	MAX FY	MIN FY	MAX MY	MIN MY	MAX MZ	MIN MZ
Vu (kip)	640.13	677.67	985.39	419.69	650.95	654.59	796.87	522.38	466.90	493.94	711.35	311.16	475.06	477.12	578.16	383.71
Vuw (kip)	960.19	1016.51	1180.39	629.53	976.43	981.88	1086.13	783.58	---	---	---	---	---	---	---	---
Mv (k*ft)	667.63	706.79	820.74	437.72	678.92	682.71	755.20	544.83	324.64	343.44	494.61	216.35	330.32	331.74	402.00	266.80
Huw (kip)	2300.71	2686.78	2278.07	3094.25	2300.10	2288.68	2220.68	3170.31	968.24	1207.44	1070.60	1316.88	1140.11	1092.58	1255.88	1203.91
Muw (k*ft)	3452.33	3319.36	3701.51	2394.29	3802.23	3668.63	4086.92	2292.87	1460.73	1833.86	1798.27	1149.90	1969.92	1815.97	2292.28	1015.21
Mu (k*ft)	4125.96	4033.14	4528.18	2840.07	4487.14	4357.30	4847.90	2845.96	1787.89	2180.45	2295.67	1369.68	2303.21	2150.56	2697.55	1285.15

Note: Mu = Muw + Mv

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		Checked	WME	Date	8/5/2011			Checked	SJL	Date	10/11/2012
For	Cleveland InnerBelt : Field Splice - Node 3281	Backchk'd	SAE	Date	8/5/2011	Sheet No.		Backchk'd	DJG	Date	10/11/2011

Web Bolt Force

	Strength I								Service II							
	MAX FX	MIN FX	MAX FY	MIN FY	MAX MY	MIN MY	MAX MZ	MIN MZ	MAX FX	MIN FX	MAX FY	MIN FY	MAX MY	MIN MY	MAX MZ	MIN MZ
PX1 (Huw)	15.87	18.53	15.71	21.34	15.86	15.78	15.32	21.86	6.68	8.33	7.38	9.08	7.86	7.54	8.66	8.30
PY1 (Vuw)	6.62	7.01	8.14	4.34	6.73	6.77	7.49	5.40	3.22	3.41	4.91	2.15	3.28	3.29	3.99	2.65
PX2 (Mu)	22.13	21.63	24.29	15.23	24.07	23.37	26.00	15.27	9.59	11.70	12.31	7.35	12.35	11.54	14.47	6.89
PY2 (Mu)	3.16	3.09	3.47	2.18	3.44	3.34	3.71	2.18	1.37	1.67	1.76	1.05	1.76	1.65	2.07	0.98
Pu (kip)	39.24	41.41	41.65	37.15	41.21	40.44	42.81	37.90	16.90	20.66	20.79	16.74	20.84	19.70	23.91	15.62

Note: Pu = $\sqrt{((PX1 + PX2)^2 + (PY1 + PY2)^2)}$

Splice Plate Design

Flange Splice Plates in Tension (6.13.5.2)

	Pu (kip)	Pry (kip)	Pru (kip)	Avg (in2)	Avn (in2)	Atn (in2)	Prbs (kip)	Rr (kip)	Check
TF Outside	2501.50	4862.81	3232.13	133.25	75.66	42.76	5891.72	3232.13	OK
TF Inside	2514.33	4887.75	3123.75	287.00	162.97	36.09	8881.86	3123.75	OK
BF Inside	2350.60	3840.38	2454.38	176.00	100.20	28.36	5880.45	2454.38	OK
BF Outside	2289.54	3740.63	2486.25	80.00	45.55	32.89	4032.93	2486.25	OK

Tension Plate Parameters

U	1.0
Rp	1.0
Ubs	1.0

assumed drilled holes

Flange Splice Plates in Compression (6.13.6.1.4c)

	Pu (kip)	Rr (kip)	Check
TF Outside	0.00	4606.88	OK
TF Inside	0.00	4630.50	OK
BF Inside	3485.18	3638.25	OK
BF Outside	3394.66	3543.75	OK

Web Splice Plates in Axial Flexure (6.13.6.1.4b)

	MAX FX	MIN FX	MAX FY	MIN FY	MAX MY	MIN MY	MAX MZ	MIN MZ
Stress (ksi)	36.20	38.20	38.15	34.62	38.07	37.33	39.44	35.14
Check	OK	OK	OK	OK	OK	OK	OK	OK

S (in3) = 2310.3

Web Splice Plates in Shear (6.13.5.3)

Vu (kip)	1180.39
Rr (kip)	2688.48
Check	OK

HNTB	The HNTB Companies Engineers Architects Planners	Made	SAE	Date	8/5/2011	Job Number	49633	Revised	DJG	Date	10/3/2012
		Checked	WME	Date	8/5/2011			Checked	SJL	Date	10/11/2012
For	Cleveland InnerBelt : Field Splice - Node 3281	Backchk'd	SAE	Date	8/5/2011	Sheet No.		Backchk'd	DJG	Date	10/11/2011

Splice Bolt Design

Shear Resistance (6.13.2.7 & 6.13.6.1.5)

Ns = 1

	Fill Pl (in)	R	L Factor	Rr (kip)
TF	0.00	1.00	1.0	36.19
Web	0.25	0.76	1.0	27.49
BF	0.00	1.00	1.0	36.19

Slip Resistance (6.13.2.8)

Kh	1.0
Ks	0.33
Ns	1.0
Pt	51.0
Rr	16.83

(Class A)

x-dir. Hole Shift (in.) = 0.0938

y-dir. Hole Shift (in.) = 0.0313

Flange Bolt

	Shear Resistance			Slip Resistance		
	Pu (kip)	Pu/Bolt	Check	Ps	Ps/Bolt	Check
TF	2514.33	14.97	OK	2097.22	12.48	OK
BF	3485.18	26.40	OK	330.06	2.50	OK

	Bearing Resistance (6.13.2.9)				
	Pu	Pu/Bolt	Lc	Rr (kip)	Check
TF Outside	2501.50	14.89	1.34	178.18	OK
TF	5015.82	29.86	1.34	328.95	OK
TF Inside	2514.33	14.97	1.34	191.89	OK
BF Inside	3485.18	26.40	1.34	150.77	OK
BF	6879.84	52.12	1.34	328.95	OK
BF Outside	3394.66	25.72	1.34	137.06	OK

Web Bolt

Shear Resistance			Slip Resistance		
Pu (dbl)	Pu (sngl)	Check	Ps (dbl)	Ps (sngl)	Check
42.81	21.41	OK	23.91	11.96	OK

	Bearing Resistance (6.13.2.9)			
	Pu/Bolt	Lc	Rr (kip)	Check
Web	42.81	1.34	83.85	OK
Web SPL	21.41	1.25	68.25	OK

Minimum edge dist. = 2" - 3/32" = 1.91" >= 1.625" for gas cut eges per Table 6.13.2.6.6-1.

Design Factor of Safety Summary

Plate	Tension	Comp
TF Outside	1.29	NA
TF Inside	1.24	NA
BF Inside	1.04	1.04
BF Outside	1.09	1.04

Bolt	Shear	Slip	Bearing
TF	2.42	1.35	11.02
Web	1.28	1.41	1.96
BF	1.37	6.73	5.33

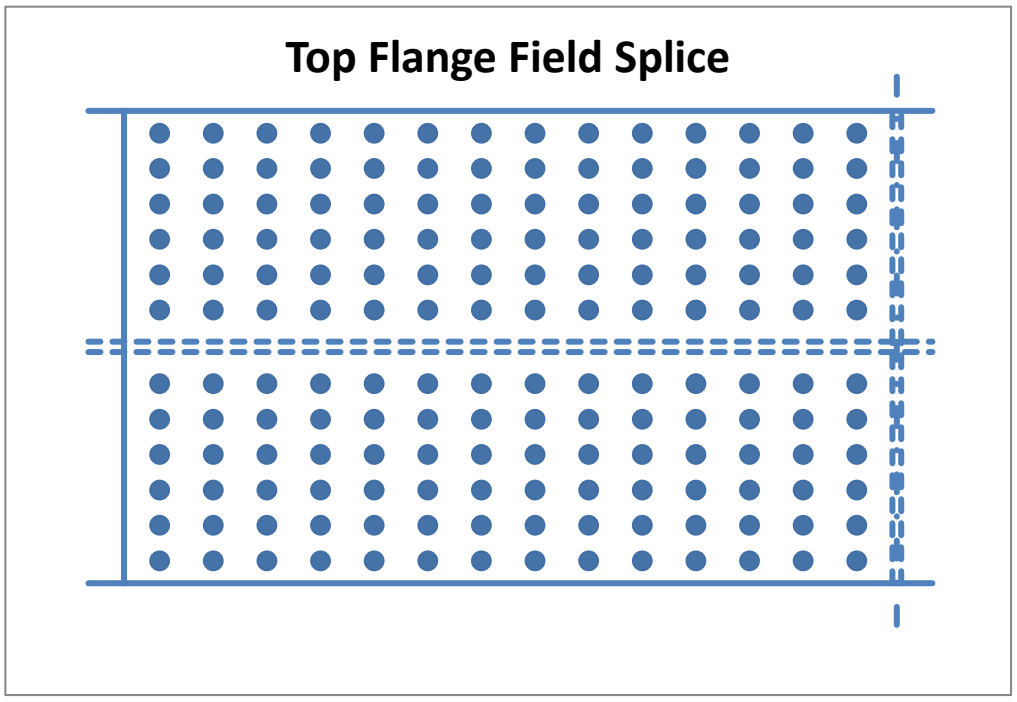
Plate	Shear	Flexure
Web	2.28	1.27

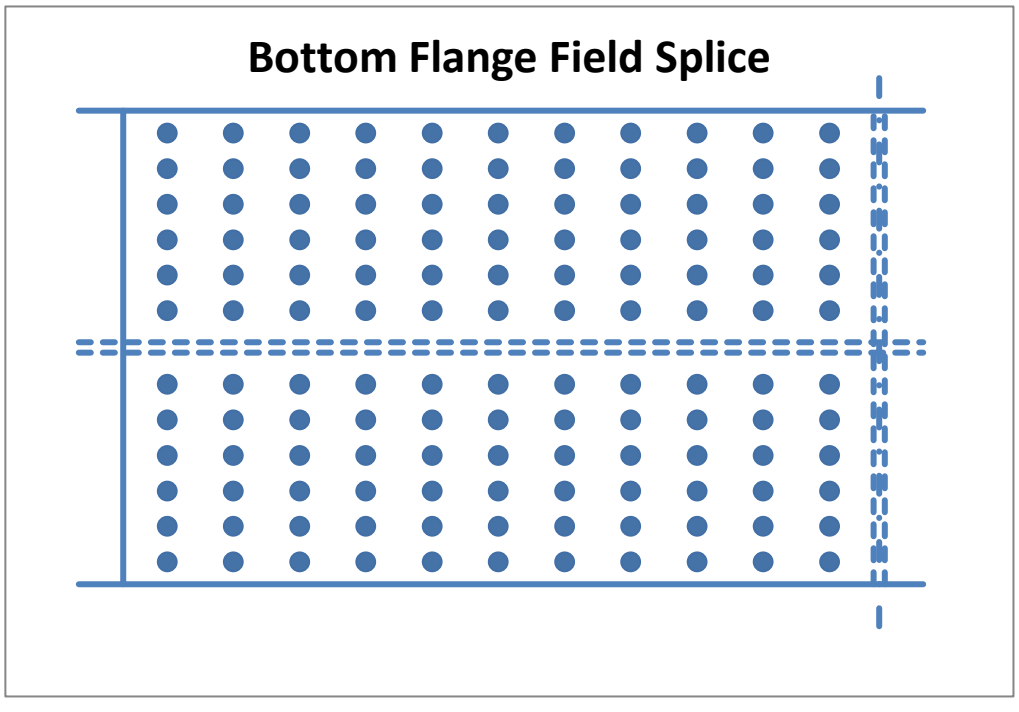
HNTB	The HNTB Companies Engineers Architects Planners	Made	SAE	Date	8/5/2011	Job Number	49633
		Checked	WME	Date	8/5/2011		
For	Cleveland InnerBelt : Field Splice - Node 3281	Backchk'd	SAE	Date	8/5/2011	Sheet No.	
		Revised	DJG	Date	10/3/2012	Revised	VWR	Date	6/19/2013
		Checked	SJL	Date	10/11/2012	Checked	SJL	Date	6/20/2013
		Backchk'd	DJG	Date	10/11/2011	Backchk'd	VWR	Date	6/21/2013

Flange Bolt Pattern - Node 3281

TF Bolt Coordinates (in)		BF Bolt Coordinates (in)	
x (long)	y (trans)	x (long)	y (trans)
0	0	0	0
0	3.375	0	3.375
0	6.75	0	6.75
0	10.125	0	10.125
0	13.5	0	13.5
0	16.875	0	16.875
0	23.875	0	23.875
0	27.25	0	27.25
0	30.625	0	30.625
0	34	0	34
0	37.375	0	37.375
0	40.75	0	40.75
3	0	3	0
3	3.375	3	3.375
3	6.75	3	6.75
3	10.125	3	10.125
3	13.5	3	13.5
3	16.875	3	16.875
3	23.875	3	23.875
3	27.25	3	27.25
3	30.625	3	30.625
3	34	3	34
3	37.375	3	37.375
3	40.75	3	40.75
6	0	6	0
6	3.375	6	3.375
6	6.75	6	6.75
6	10.125	6	10.125
6	13.5	6	13.5
6	16.875	6	16.875
6	23.875	6	23.875
6	27.25	6	27.25
6	30.625	6	30.625
6	34	6	34
6	37.375	6	37.375
6	40.75	6	40.75
9	0	9	0
9	3.375	9	3.375
9	6.75	9	6.75
9	10.125	9	10.125
9	13.5	9	13.5
9	16.875	9	16.875
9	23.875	9	23.875
9	27.25	9	27.25
9	30.625	9	30.625
9	34	9	34
9	37.375	9	37.375
9	40.75	9	40.75
12	0	12	0
12	3.375	12	3.375
12	6.75	12	6.75
12	10.125	12	10.125
12	13.5	12	13.5
12	16.875	12	16.875
12	23.875	12	23.875
12	27.25	12	27.25
12	30.625	12	30.625
12	34	12	34
12	37.375	12	37.375

	Top Flange		Bottom Flange	
No. Bolts =	168.0		132.0	
Splice Plate to First Column (in) =	2.000	OK	2.000	OK
No. Longitudinal Space =	13.0		10.0	
Longitudinal Spacing (in) =	3.000	OK	3.000	OK
Last Column to End Girder (in) =	2.000	OK	2.000	OK
Gap (in) =	0.500		0.500	
Edge Flange to First Row (in) =	2.125	OK	2.125	OK
No. Trans Space (per side of web) =	5.0		5.0	
Transverse Spacing (in) =	3.375	OK	3.375	OK
Center Row to CL Web (in) =	3.500		3.500	
Bolt Stagger =	NO		NO	





HNTB	The HNTB Companies Engineers Architects Planners	Made	SAE	Date	8/5/2011	Job Number	49633
		Checked	WME	Date	8/5/2011		
For	Cleveland InnerBelt : Field Splice - Node 3281	Backchk'd	SAE	Date	8/5/2011	Sheet No.	

12	40.75	12	40.75
15	0	15	0
15	3.375	15	3.375
15	6.75	15	6.75
15	10.125	15	10.125
15	13.5	15	13.5
15	16.875	15	16.875
15	23.875	15	23.875
15	27.25	15	27.25
15	30.625	15	30.625
15	34	15	34
15	37.375	15	37.375
15	40.75	15	40.75
18	0	18	0
18	3.375	18	3.375
18	6.75	18	6.75
18	10.125	18	10.125
18	13.5	18	13.5
18	16.875	18	16.875
18	23.875	18	23.875
18	27.25	18	27.25
18	30.625	18	30.625
18	34	18	34
18	37.375	18	37.375
18	40.75	18	40.75
21	0	21	0
21	3.375	21	3.375
21	6.75	21	6.75
21	10.125	21	10.125
21	13.5	21	13.5
21	16.875	21	16.875
21	23.875	21	23.875
21	27.25	21	27.25
21	30.625	21	30.625
21	34	21	34
21	37.375	21	37.375
21	40.75	21	40.75
24	0	24	0
24	3.375	24	3.375
24	6.75	24	6.75
24	10.125	24	10.125
24	13.5	24	13.5
24	16.875	24	16.875
24	23.875	24	23.875
24	27.25	24	27.25
24	30.625	24	30.625
24	34	24	34
24	37.375	24	37.375
24	40.75	24	40.75
27	0	27	0
27	3.375	27	3.375
27	6.75	27	6.75
27	10.125	27	10.125
27	13.5	27	13.5
27	16.875	27	16.875
27	23.875	27	23.875
27	27.25	27	27.25
27	30.625	27	30.625
27	34	27	34
27	37.375	27	37.375
27	40.75	27	40.75
30	0	30	0
30	3.375	30	3.375
30	6.75	30	6.75
30	10.125	30	10.125
30	13.5	30	13.5

Flange Bolt Pattern Cont. - Node 3281

30	16.875	30	16.875
30	23.875	30	23.875
30	27.25	30	27.25
30	30.625	30	30.625
30	34	30	34
30	37.375	30	37.375
30	40.75	30	40.75
33	0		
33	3.375		
33	6.75		
33	10.125		
33	13.5		
33	16.875		
33	23.875		
33	27.25		
33	30.625		
33	34		
33	37.375		
33	40.75		
36	0		
36	3.375		
36	6.75		
36	10.125		
36	13.5		
36	16.875		
36	23.875		
36	27.25		
36	30.625		
36	34		
36	37.375		
36	40.75		
39	0		
39	3.375		
39	6.75		
39	10.125		
39	13.5		
39	16.875		
39	23.875		
39	27.25		
39	30.625		
39	34		
39	37.375		
39	40.75		

Flange Bolt Pattern Cont. - Node 3281

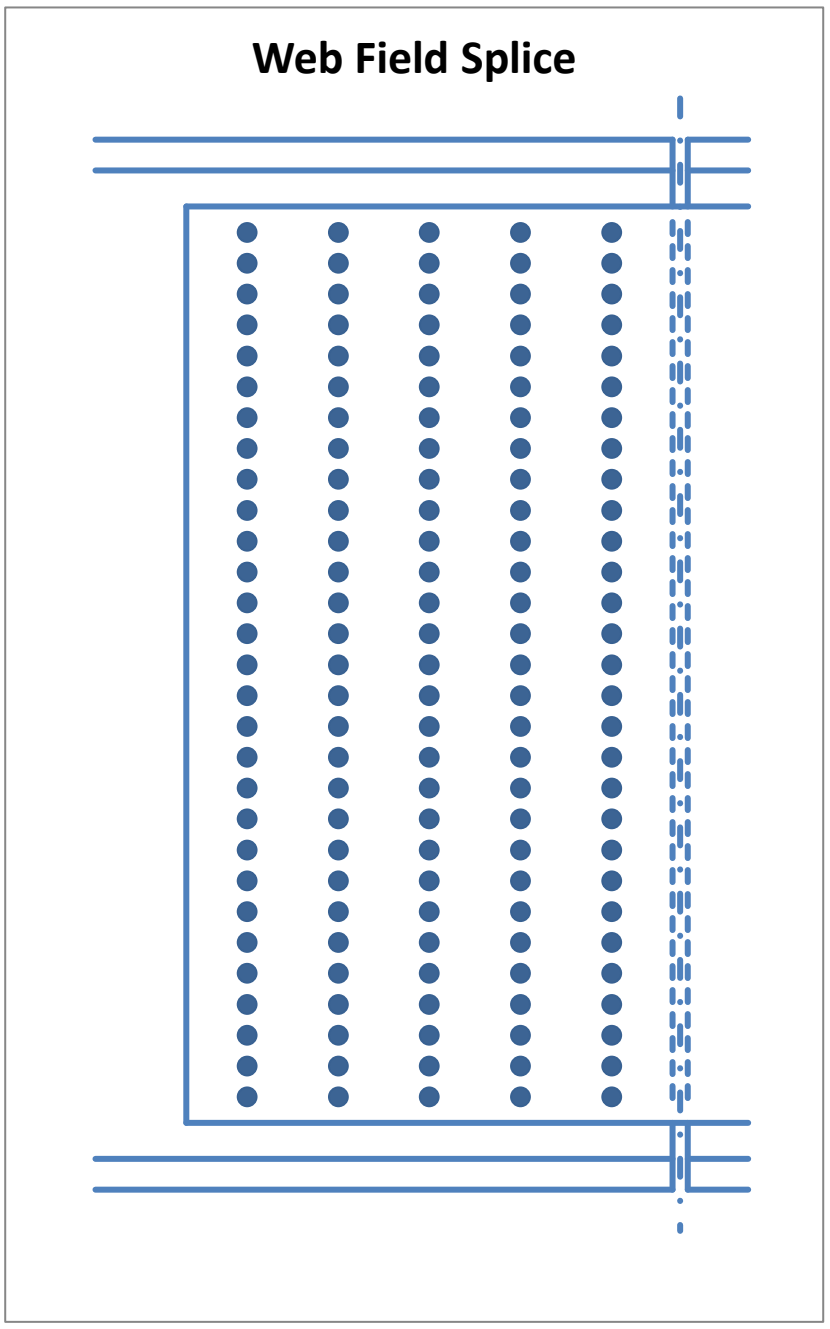
HNTB	The HNTB Companies Engineers Architects Planners	Made	SAE	Date	8/5/2011	Job Number	49633
		Checked	WME	Date	8/5/2011		
For	Cleveland InnerBelt : Field Splice - Node 3281	Backchk'd	SAE	Date	8/5/2011	Sheet No.	

Web Bolt Pattern - Node 3281

Note: Hole shift is constant for all bolts. Values computed in this geometry worksheet don't change relative to the origin (i.e. lower left bolt in pattern). Computed centroid can be adjusted in Type N worksheet as needed.

Bolt Coordinates (in)			
x (long)	y (vert)	$(x-x_{bar})^2$	$(y-y_{bar})^2$
0	0	36	1764
0	3	36	1521
0	6	36	1296
0	9	36	1089
0	12	36	900
0	15	36	729
0	18	36	576
0	21	36	441
0	24	36	324
0	27	36	225
0	30	36	144
0	33	36	81
0	36	36	36
0	39	36	9
0	42	36	0
0	45	36	9
0	48	36	36
0	51	36	81
0	54	36	144
0	57	36	225
0	60	36	324
0	63	36	441
0	66	36	576
0	69	36	729
0	72	36	900
0	75	36	1089
0	78	36	1296
0	81	36	1521
0	84	36	1764
3	0	9	1764
3	3	9	1521
3	6	9	1296
3	9	9	1089
3	12	9	900
3	15	9	729
3	18	9	576
3	21	9	441
3	24	9	324
3	27	9	225
3	30	9	144
3	33	9	81
3	36	9	36
3	39	9	9
3	42	9	0
3	45	9	9
3	48	9	36
3	51	9	81
3	54	9	144
3	57	9	225
3	60	9	324
3	63	9	441
3	66	9	576
3	69	9	729
3	72	9	900
3	75	9	1089
3	78	9	1296
3	81	9	1521
3	84	9	1764
6	0	0	1764

No. Bolts =	145.0	
Splice Plate to First Column (in) =	2.000	OK
No. Longitudinal Space =	4.0	
Longitudinal Spacing (in) =	3.000	OK
Last Column to End Girder (in) =	2.000	OK
Gap (in) =	0.500	
Top/Bot Web to First Row (in) =	6.000	OK
Splice Plate to First Row (in) =	2.500	OK
No. Vertical Space =	28.0	
Vertical Spacing (in) =	3.000	OK
Bolt Stagger =	NO	
x_{bar} (in) =	6	
y_{bar} (in) =	42	
$\Sigma(x\text{-}xbar)^2$ (in^2)=	2610	
$\Sigma(y\text{-}ybar)^2$ (in^2) =	91350	
Σd^2 (in^2) =	93960	



HNTB	The HNTB Companies Engineers Architects Planners	Made	SAE	Date	8/5/2011	Job Number	49633
		Checked	WME	Date	8/5/2011		
For	Cleveland InnerBelt : Field Splice - Node 3281	Backchk'd	SAE	Date	8/5/2011	Sheet No.	

6	3	0	1521
6	6	0	1296
6	9	0	1089
6	12	0	900
6	15	0	729
6	18	0	576
6	21	0	441
6	24	0	324
6	27	0	225
6	30	0	144
6	33	0	81
6	36	0	36
6	39	0	9
6	42	0	0
6	45	0	9
6	48	0	36
6	51	0	81
6	54	0	144
6	57	0	225
6	60	0	324
6	63	0	441
6	66	0	576
6	69	0	729
6	72	0	900
6	75	0	1089
6	78	0	1296
6	81	0	1521
6	84	0	1764
9	0	9	1764
9	3	9	1521
9	6	9	1296
9	9	9	1089
9	12	9	900
9	15	9	729
9	18	9	576
9	21	9	441
9	24	9	324
9	27	9	225
9	30	9	144
9	33	9	81
9	36	9	36
9	39	9	9
9	42	9	0
9	45	9	9
9	48	9	36
9	51	9	81
9	54	9	144
9	57	9	225
9	60	9	324
9	63	9	441
9	66	9	576
9	69	9	729
9	72	9	900
9	75	9	1089
9	78	9	1296
9	81	9	1521
9	84	9	1764
12	0	36	1764
12	3	36	1521
12	6	36	1296
12	9	36	1089
12	12	36	900
12	15	36	729
12	18	36	576
12	21	36	441
12	24	36	324

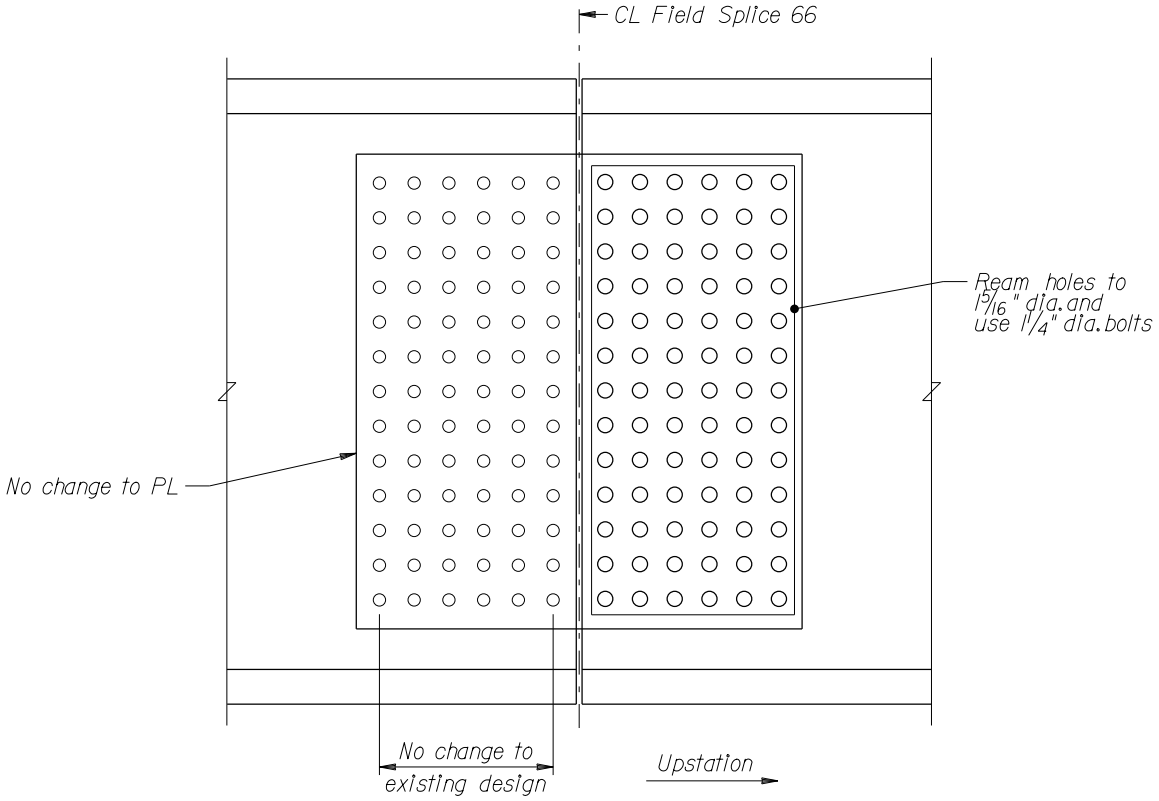
Web Bolt Pattern Cont. - Node 3281

HNTB	The HNTB Companies Engineers Architects Planners	Made	SAE	Date	8/5/2011	Job Number	49633
		Checked	WME	Date	8/5/2011		
For	Cleveland InnerBelt : Field Splice - Node 3281	Backchk'd	SAE	Date	8/5/2011	Sheet No.	

12	27	36	225
12	30	36	144
12	33	36	81
12	36	36	36
12	39	36	9
12	42	36	0
12	45	36	9
12	48	36	36
12	51	36	81
12	54	36	144
12	57	36	225
12	60	36	324
12	63	36	441
12	66	36	576
12	69	36	729
12	72	36	900
12	75	36	1089
12	78	36	1296
12	81	36	1521
12	84	36	1764
870	6090	2610	91350

Web Bolt Pattern Cont. - Node 3281

PROJECT	MADE	DATE	
Cleveland Innerbelt	VWR	06-20-13	HNTB
STRUCTURE	CHECKED	DATE	
I-90 WB - Unit 2	SJL	06-21-13	
FOR	BACK CHECKED	DATE	PROJECT NUMBER
RFI 457 - FS 66, Girder 2	VWR	06-21-13	49633



Notes:
1. Flange splice not shown for clarity.
2. All material and workmanship shall be in accordance with the RFC plans.
3. The center of the reamed holes shall be shifted vertically 3/32" (up) to allow conflicting material to be removed.
4. Bolts shall be high strength A325 galvanized Type 1 bolts.
5. Final reamed holes through splice plates and web shall be circular and concentric.

HNTB The HNTB Companies Engineers Architects Planners	Made	WME	Date	8/5/2011	Job Number	49633	Revised	DJG	Date	10/3/2012
	Checked	MTB	Date	8/5/2011			Checked	SJL		10/11/2011
For Cleveland InnerBelt : Field Splice - Node 3556	Backchk'd	WME	Date	8/5/2011	Sheet No.		Backchk'd	DJG		10/11/2011

N:\49633\Bridges\Design\Final Design\Unit 2\NDC65_MODEL\RFIs\[Field Splice Legs-2013-06-20.xlsm]Type LL

Field Splice - Node 3556

Initials for all pages of worksheet "Type LL" for Node 3556.	Revised	VWR	Date	6/20/2013
	Checked	SJL		6/21/2013
	Backchk'd	VWR		6/21/2013

Node 3556

Resisance Factors (6.5.4.2)

ϕf	1.00
ϕv	1.00
ϕc	0.90
ϕu	0.80
ϕy	0.95
ϕbb	0.80
ϕs	0.80
ϕbs	0.80
ϕvu	0.80

A325 Bolt

Dia. (in)	1.00
A (in2)	0.79
Fub (ksi)	120
Hole (in)	1.3125

(6.13.2.4.2-1)

	No. Bolt
TF	192
Web	78
BF	132

Notes:

For RFI 457, the web splice and pertinent web splice input was updated. In the field, 1.25 in. dia. bolts will be used in half the web splice where holes will be reamed to 1.3125 in. dia. With a 1.25 in. bolt, Fub is reduced from 120 ksi to 105 ksi (13% reduction), the area of the bolt is increased by 56%. Therefore using 1 in. dia. bolts and 1.3125 in. holes in this worksheet for both the flanges and web will be conservative. Flange splices were not re-evaluated.

For RFI 457, all holes on one side of the web are shifted a constant dimension. Values computed in the geometry worksheet won't change relative to the origin (i.e. lower left bolt in pattern). Therefore the computed centroid of bolt group is adjusted below.

Determine Controlling Section

Section	Top Flange Area	Top Flange ϕf Fnc	Top Flange A*Fnc	Bottom Flange Area	Bottom Flange ϕf Fnc	Bottom Flange A*Fnc	Web Area	Web Fyw	Web A*Fyw
3556 L	135.00	69.57	9391.43	135.00	69.57	9391.43	48.00	50.00	2400.00
3556 R	144.00	68.43	9854.45	135.00	69.35	9362.40	72.00	50.00	3600.00

Rh = 0.99

Controlling Section = 3556 L

Section and Material Properties

		b (in)	t (in)	L (in)	Ag (in2)	An (in2)	Ae (in2)	Fy (ksi)	Fu (ksi)
Girder Section	TF	45.00	3.00	---	135.00	87.75	89.73	70	85
	Web	48.00	1.00	---	48.00	30.94	---	50	65
	BF	45.00	3.00	---	135.00	87.75	89.73	70	85
Splice Plates	TF Outside	45.00	1.625	94.75	73.13	47.53	---	70	85
	TF Inside	21.00	1.750	94.75	73.50	45.94	---	70	85
	BF Inside	21.00	1.375	68.50	57.75	36.09	---	70	85
	BF Outside	45.00	1.250	68.50	56.25	36.56	---	70	85
	Web	41.00	1.000	38.50	82.00	47.88	---	50	65

Max Outer to Inner stress ratio
0.889

N.A. (from l	27.00	in
Outer to Inner flange ratio top	0.889	
Outer to Inner flange ratio bot	0.889	
Outer to Mid flange ratio top	0.944	
Outer to Mid flange ratio bot	0.944	

HNTB The HNTB Companies Engineers Architects Planners	Made	WME	Date	8/5/2011	Job Number	49633	Revised	DJG	Date	10/3/2012
	Checked	MTB	Date	8/5/2011			Checked	SJL		10/11/2011
For Cleveland InnerBelt : Field Splice - Node 3556	Backchk'd	WME	Date	8/5/2011	Sheet No.		Backchk'd	DJG		10/11/2011

Flange Design Forces Strength I-V (6.13.6.1.4c)

	MAX FX		MIN FX		MAX FY		MIN FY		MAX MY		MIN MY		MAX MZ		MIN MZ	
	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF
f (ksi)	-32.40	-8.91	-34.70	-18.54	-26.77	-18.38	-41.55	-8.42	-41.37	-12.64	-27.28	-17.70	-41.54	-7.17	-26.72	-20.07
ϕf Fnc (ksi)	69.57	69.57	69.57	69.57	69.57	69.57	69.57	69.57	69.57	69.57	69.57	69.57	69.57	69.57	69.57	69.57
f / ϕf Fnc	0.47	0.13	0.50	0.27	0.38	0.26	0.60	0.12	0.59	0.18	0.39	0.25	0.60	0.10	0.38	0.29
α	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
fcf (ksi)	-32.40		-34.70		-26.77		-41.55		-41.37		-27.28		-41.54		-26.72	
Fcf (ksi)	-52.17		-52.24		-52.17		-55.69		-55.60		-52.17		-55.68		-52.17	
Fcf (kip)	-7043.57		-7052.40		-7043.57		-7517.83		-7505.90		-7043.57		-7517.26		-7043.57	
fncf (ksi)		-8.91		-18.54		-18.38		-8.42		-12.64		-17.70		-7.17		-20.07
Rcf		1.26		1.26		1.26		1.34		1.34		1.26		1.34		1.26
Fncf (ksi)		-52.17		-52.17		-52.17		-52.17		-52.17		-52.17		-52.17		-52.17
Fncf (kip)		-7043.57		-7043.57		-7043.57		-7043.57		-7043.57		-7043.57		-7043.57		-7043.57

Flange Design Forces - Service II (6.13.6.1.4c)

	MAX FX		MIN FX		MAX FY		MIN FY		MAX MY		MIN MY		MAX MZ		MIN MZ	
	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF
f (ksi)	-23.88	-5.76	-25.83	-13.45	-20.07	-13.49	-30.54	-5.21	-30.80	-9.02	-20.50	-12.78	-30.56	-4.30	-20.00	-14.72
Fs (ksi)	-23.88	-5.76	-25.83	-13.45	-20.07	-13.49	-30.54	-5.21	-30.80	-9.02	-20.50	-12.78	-30.56	-4.30	-20.00	-14.72
Fs (kip)	-3223.68	-777.14	-3486.48	-1815.52	-2708.88	-1821.64	-4123.09	-703.92	-4158.08	-1217.23	-2767.86	-1725.12	-4125.74	-580.61	-2699.58	-1987.15

Max Flange Design Forces

	Strength I		Service II	
Pu	TF	BF	TF	BF
Tension	0.00	0.00	0.00	0.00
Comp	7517.83	7043.57	4158.08	1987.15

ϕvVn (kip) = 1392.00

e_v (in) = 6.750

e_h (in) = 0.0938 Note: 3/32" eccentricity added due to shifted bolt group.

Web Design Forces (6.13.6.1.4b)

	Strength I								Service II							
	MAX FX	MIN FX	MAX FY	MIN FY	MAX MY	MIN MY	MAX MZ	MIN MZ	MAX FX	MIN FX	MAX FY	MIN FY	MAX MY	MIN MY	MAX MZ	MIN MZ
Vu (kip)	563.33	642.07	496.16	753.91	695.33	540.66	741.71	510.69	410.99	464.74	361.65	545.64	502.37	394.97	537.02	371.92
Vuw (kip)	844.99	963.10	744.24	1072.96	1042.99	810.99	1066.85	766.03	---	---	---	---	---	---	---	---
Mv (k*ft)	475.31	541.75	418.64	603.54	586.68	456.18	600.11	430.89	231.18	261.42	203.43	306.92	282.58	222.17	302.07	209.20
Huw (kip)	-1512.97	-1805.56	-1798.46	-1599.13	-1731.92	-1777.92	-1558.59	-1849.24	-711.26	-942.58	-805.43	-858.14	-955.61	-798.75	-836.68	-833.20
Muw (k*ft)	650.59	457.61	460.27	704.87	613.53	473.96	731.77	426.41	289.96	198.04	105.15	405.23	348.55	123.58	420.16	84.44
Mu (k*ft)	1125.90	999.36	878.90	1308.41	1200.22	930.14	1331.87	857.31	521.14	459.45	308.58	712.15	631.13	345.75	722.23	293.64

Note: Mu = Muw + Mv

HNTB The HNTB Companies Engineers Architects Planners	Made	WME	Date	8/5/2011	Job Number	49633	Revised	DJG	Date	10/3/2012
	Checked	MTB	Date	8/5/2011			Checked	SJL		10/11/2011
For Cleveland InnerBelt : Field Splice - Node 3556	Backchk'd	WME	Date	8/5/2011	Sheet No.		Backchk'd	DJG		10/11/2011

Web Bolt Force

	Strength I								Service II							
	MAX FX	MIN FX	MAX FY	MIN FY	MAX MY	MIN MY	MAX MZ	MIN MZ	MAX FX	MIN FX	MAX FY	MIN FY	MAX MY	MIN MY	MAX MZ	MIN MZ
PX1 (Huw)	19.40	23.15	23.06	20.50	22.20	22.79	19.98	23.71	9.12	12.08	10.33	11.00	12.25	10.24	10.73	10.68
PY1 (Vuw)	10.83	12.35	9.54	13.76	13.37	10.40	13.68	9.82	5.27	5.96	4.64	7.00	6.44	5.06	6.88	4.77
PX2 (Mu)	20.48	18.18	15.99	23.80	21.83	16.92	24.23	15.59	9.48	8.36	5.61	12.95	11.48	6.29	13.14	5.34
PY2 (Mu)	8.53	7.57	6.66	9.92	9.10	7.05	10.09	6.50	3.95	3.48	2.34	5.40	4.78	2.62	5.47	2.23
Pu (kip)	44.33	45.88	42.27	50.23	49.44	43.38	50.19	42.55	20.76	22.52	17.40	26.97	26.25	18.23	26.87	17.48

Note: $Pu = \sqrt{((PX1 + PX2)^2 + (PY1 + PY2)^2)}$

Splice Plate Design

Flange Splice Plates in Tension (6.13.5.2)

	Pu (kip)	Pry (kip)	Pru (kip)	Avg (in2)	Avn (in2)	Atn (in2)	Prbs (kip)	Rr (kip)	Check
TF Outside	0.00	4862.81	3232.13	146.66	80.54	42.76	6083.99	3232.13	OK
TF Inside	0.00	4887.75	3123.75	315.88	173.47	36.09	9295.98	3123.75	OK
BF Inside	0.00	3840.38	2454.38	176.00	100.20	28.36	5880.45	2454.38	OK
BF Outside	0.00	3740.63	2486.25	80.00	45.55	32.89	4032.93	2486.25	OK

Tension Plate Parameters

U	1.0
Rp	1.0
Ubs	1.0

assumed drilled holes

Flange Splice Plates in Compression (6.13.6.1.4c)

	Pu (kip)	Rr (kip)	Check
TF Outside	3749.30	4606.88	OK
TF Inside	3768.53	4630.50	OK
BF Inside	3568.13	3638.25	OK
BF Outside	3475.45	3543.75	OK

Web Splice Plates in Axial Flexure (6.13.6.1.4b)

	MAX FX	MIN FX	MAX FY	MIN FY	MAX MY	MIN MY	MAX MZ	MIN MZ
Stress (ksi)	42.56	43.42	40.75	47.52	46.82	41.60	47.53	40.91
Check	OK	OK	OK	OK	OK	OK	OK	OK

S (in3) = 560.3

Web Splice Plates in Shear (6.13.5.3)

Vu (kip)	1072.96
Rr (kip)	1443.91
Check	OK

HNTB The HNTB Companies Engineers Architects Planners		Made	WME	Date	8/5/2011	Job Number	49633	Revised	DJG	Date	10/3/2012
		Checked	MTB	Date	8/5/2011			Checked	SJL		10/11/2011
For	Cleveland InnerBelt : Field Splice - Node 3556	Backchk'd	WME	Date	8/5/2011	Sheet No.		Backchk'd	DJG		10/11/2011

Splice Bolt Design

Shear Resistance (6.13.2.7 & 6.13.6.1.5)

Ns = 1

	Fill Pl (in)	R_{fill}	R_{length}	Rr (kip)
TF	0.00	1.00	1.0	36.19
Web	0.25	0.77	1.0	27.85
BF	0.00	1.00	1.0	36.19

Slip Resistance (6.13.2.8)

Kh	1.0
Ks	0.33
Ns	1.0
Pt	51.0
Rr	16.83

(Class A)

0.48 Threads excluded set for flanges

0.48 Threads excluded set for webs

Flange Bolt

	Shear Resistance			Slip Resistance		
	Pu (kip)	Pu/Bolt	Check	Ps	Ps/Bolt	Check
TF	3768.53	19.63	OK	2084.35	10.86	OK
BF	3568.13	27.03	OK	1006.65	7.63	OK

	Bearing Resistance (6.13.2.9)				
	Pu	Pu/Bolt	Lc	Rr (kip)	Check
TF Outside	3749.30	19.53	1.34	178.18	OK
TF	7517.83	39.16	1.34	328.95	OK
TF Inside	3768.53	19.63	1.34	191.89	OK
BF Inside	3568.13	27.03	1.34	150.77	OK
BF	7043.57	53.36	1.34	328.95	OK
BF Outside	3475.45	26.33	1.34	137.06	OK

Web Bolt

Shear Resistance			Slip Resistance		
Pu (dbl)	Pu (sngl)	Check	Ps (dbl)	Ps (sngl)	Check
50.23	25.11	OK	26.97	13.49	OK

	Bearing Resistance (6.13.2.9)			
	Pu/Bolt	Lc	Rr (kip)	Check
Web	50.23	1.34	83.85	OK
Web SPL	25.11	1.34	83.85	OK

Design Factor of Safety Summary

Plate	Tension	Comp
TF Outside	NA	1.23
TF Inside	NA	1.23
BF Inside	NA	1.02
BF Outside	NA	1.02

Bolt	Shear	Slip	Bearing
TF	1.84	1.55	8.40
Web	1.13	1.35	1.70
BF	1.34	2.21	5.21

Plate	Shear	Flexure
Web	1.35	1.08

HNTB	The HNTB Companies Engineers Architects Planners	Made	WME	Date	8/5/2011	Job Number	49633
		Checked	MTB	Date	8/5/2011		
For	Cleveland InnerBelt : Field Splice - Node 3556	Backchk'd	WME	Date	8/5/2011	Sheet No.	

For use in Web Splice MY components of stress in flanges not included for web splices.

Flange Design Forces Strength I-V (6.13.6.1.4c)

	MAX FX		MIN FX		MAX FY		MIN FY		MAX MY		MIN MY		MAX MZ		MIN MZ	
	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF
f (ksi)	-28.41	-6.64	-31.69	-16.72	-24.73	-16.96	-37.11	-6.41	-35.16	-8.52	-26.23	-17.35	-36.74	-4.88	-25.20	-19.03
ϕf Fnc (ksi)	69.57	69.57	69.57	69.57	69.57	69.57	69.57	69.57	69.57	69.57	69.57	69.57	69.57	69.57	69.57	69.57
f / ϕf Fnc	0.41	0.10	0.46	0.24	0.36	0.24	0.53	0.09	0.51	0.12	0.38	0.25	0.53	0.07	0.36	0.27
α	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
fcf (ksi)	-28.41		-31.69		-24.73		-37.11		-35.16		-26.23		-36.74		-25.20	
Fcf (ksi)	-52.17		-52.17		-52.17		-53.45		-52.47		-52.17		-53.27		-52.17	
Fcf (kip)	-7043.57		-7043.57		-7043.57		-7216.16		-7083.49		-7043.57		-7190.95		-7043.57	
fncf (ksi)		-6.64		-16.72		-16.96		-6.41		-8.52		-17.35		-4.88		-19.03
Rcf		1.41		1.41		1.41		1.44		1.41		1.41		1.44		1.41
Fncf (ksi)		-52.17		-52.17		-52.17		-52.17		-52.17		-52.17		-52.17		-52.17
Fncf (kip)		-7043.57		-7043.57		-7043.57		-7043.57		-7043.57		-7043.57		-7043.57		-7043.57

Flange Design Forces - Service II (6.13.6.1.4c)

	MAX FX		MIN FX		MAX FY		MIN FY		MAX MY		MIN MY		MAX MZ		MIN MZ	
	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF	TF	BF
f (ksi)	-20.79829	-4.921968	-23.01949	-12.1762	-18.10606	-12.34855	-26.94643	-4.758479	-25.47055	-6.386533	-19.25864	-12.49202	-26.68413	-3.678748	-18.44	-13.81
Fs (ksi)	-20.80	-4.92	-23.02	-12.18	-18.11	-12.35	-26.95	-4.76	-25.47	-6.39	-19.26	-12.49	-26.68	-3.68	-18.44	-13.81
Fs (kip)	-2807.77	-664.47	-3107.63	-1643.79	-2444.32	-1667.05	-3637.77	-642.39	-3438.52	-862.18	-2599.92	-1686.42	-3602.36	-496.63	-2489.12	-1865.00

Vu (kip)	563.33	642.07	496.16	753.91	695.33	540.66	741.71	510.69	410.99	464.74	361.65	545.64	502.37	394.97	537.02	371.92
Vuw (kip)	844.99	963.10	744.24	1072.96	1042.99	810.99	1066.85	766.03	---	---	---	---	---	---	---	---
Mv (k*ft)	475.31	541.75	418.64	603.54	586.68	456.18	600.11	430.89	231.18	261.42	203.43	306.92	282.58	222.17	302.07	209.20
Huw (kip)	-1468.40	-1808.47	-1816.70	-1496.38	-1540.63	-1829.95	-1438.50	-1886.73	-617.29	-844.70	-730.91	-760.92	-764.57	-762.02	-728.71	-774.07
Muw (k*ft)	680.31	453.59	448.10	702.31	641.55	439.28	734.96	401.42	254.02	173.49	92.12	355.01	305.34	108.27	368.09	73.97
Mu (k*ft)	1167.09	1009.47	880.93	1317.54	1240.27	909.76	1346.30	847.05	490.02	441.51	301.26	667.87	593.90	336.39	675.85	289.22

HNTB	The HNTB Companies Engineers Architects Planners	Made	WME	Date	8/5/2011	Job Number	49633
		Checked	MTB	Date	8/5/2011		
For	Cleveland InnerBelt : Field Splice - Node 3556	Backchk'd	WME	Date	8/5/2011	Sheet No.	

	Strength I								Service II							
	MAX FX	MIN FX	MAX FY	MIN FY	MAX MY	MIN MY	MAX MZ	MIN MZ	MAX FX	MIN FX	MAX FY	MIN FY	MAX MY	MIN MY	MAX MZ	MIN MZ
PX1 (Huw)	18.83	23.19	23.29	19.18	19.75	23.46	18.44	24.19	7.91	10.83	9.37	9.76	9.80	9.77	9.34	9.92
PY1 (Vuw)	10.83	12.35	9.54	13.76	13.37	10.40	13.68	9.82	5.27	5.96	4.64	7.00	6.44	5.06	6.88	4.77
PX2 (Mu)	21.23	18.36	16.02	23.96	22.56	16.55	24.49	15.41	8.91	8.03	5.48	12.15	10.80	6.12	12.29	5.26
PY2 (Mu)	8.84	7.65	6.68	9.99	9.40	6.89	10.20	6.42	3.71	3.35	2.28	5.06	4.50	2.55	5.12	2.19
Pu (kip)	44.63	46.11	42.53	49.25	48.05	43.59	49.12	42.80	19.07	21.03	16.38	25.00	23.33	17.62	24.74	16.70

Web Splice Plates in Axial Flexure (6.13.6.1.4b)

	MAX FX	MIN FX	MAX FY	MIN FY	MAX MY	MIN MY	MAX MZ	MIN MZ
Stress (ksi)	42.90	43.67	41.02	46.46	45.35	41.80	46.37	41.15
Check	OK	OK	OK	OK	OK	OK	OK	OK

HNTB The HNTB Companies Engineers Architects Planners		Made	WME	Date	8/5/2011	Job Number	49633
		Checked	MTB	Date	8/5/2011		
For	Cleveland InnerBelt : Field Splice - Node 3556	Backchk'd	WME	Date	8/5/2011	Sheet No.	

y-dir. Hole Shift (in.) = 0.0938

Web Bolt

Shear Resistance			Slip Resistance		
Pu (dbl)	Pu (sngl)	Check	Ps (dbl)	Ps (sngl)	Check
49.25	24.62	OK	25.00	12.50	OK

	Bearing Resistance (6.13.2.9)			
	Pu/Bolt	Lc	Rr (kip)	Check
Web	49.25	1.34	83.85	OK
Web SPL	24.62	1.34	83.85	OK

Minimum edge dist. = 2.5" - 3/32" = 2.41" >= 1.625" for gas cut eges per Table 6.13.2.6.6-1.

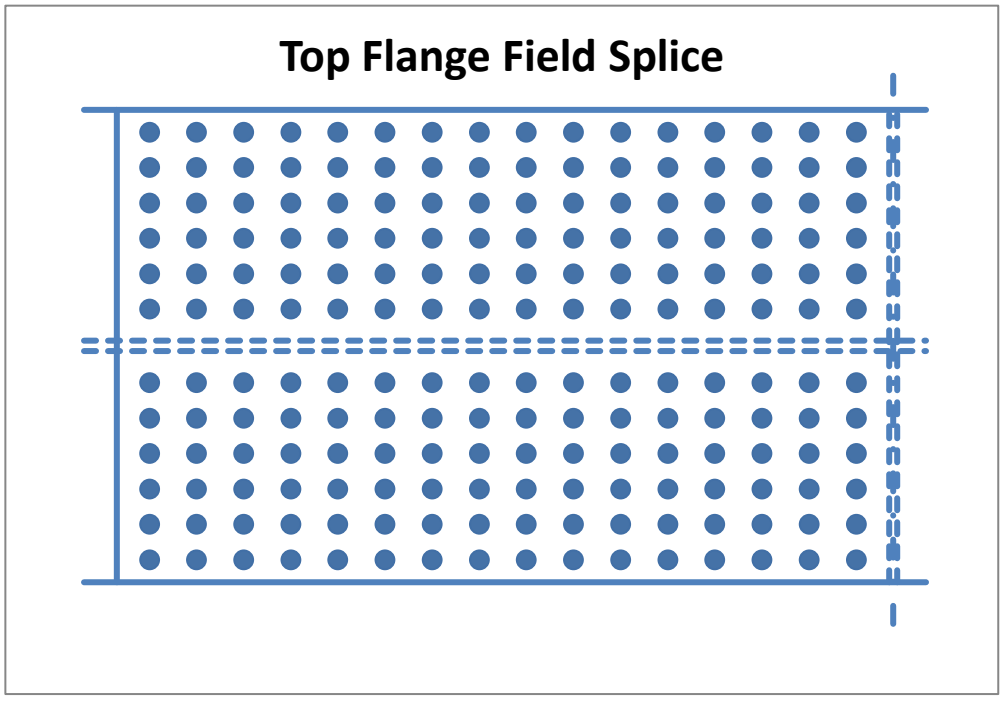
HNTB	The HNTB Companies Engineers Architects Planners	Made	SAE	Date	6/10/2011	Job Number	49633
		Checked	MCC	Date	6/10/2011		
For	Cleveland InnerBelt : Field Splice - Node 3556	Backchk'd	SAE	Date	6/10/2011	Sheet No.	

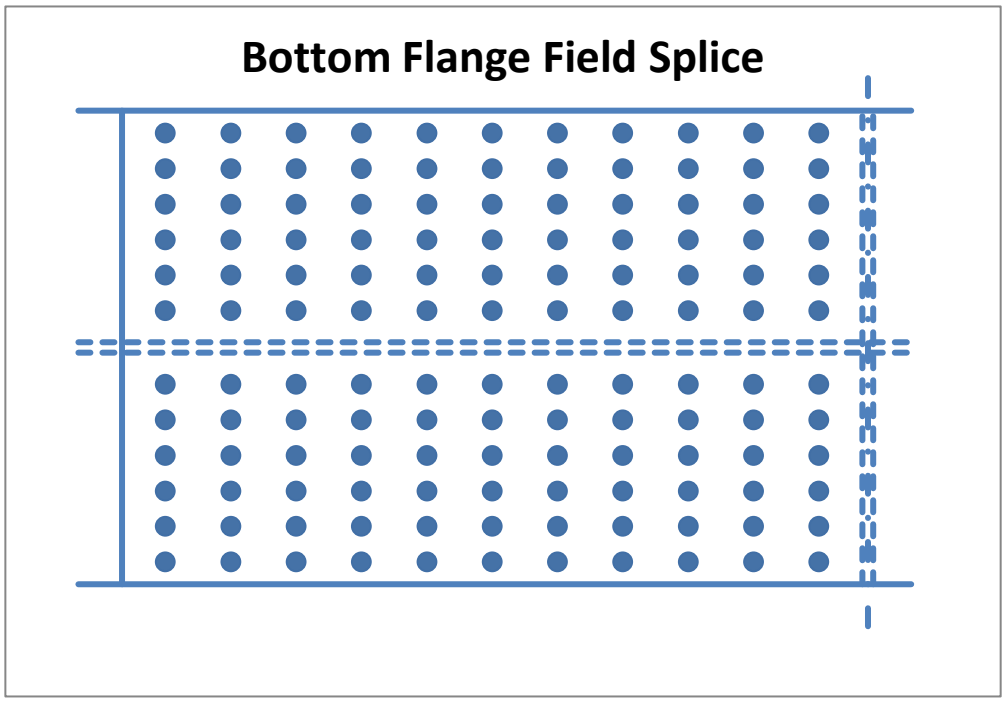
Revised	DJG	Date	10/3/2012	Revised	VWR	Date	6/20/2013
Checked	SJL		10/11/2011	Checked	SJL		6/21/2013
Backchk'd	DJG		10/11/2011	Backchk'd	VWR		6/21/2013

Flange Bolt Pattern - Node 3556

TF Bolt Coordinates (in)		BF Bolt Coordinates (in)	
x (long)	y (trans)	x (long)	y (trans)
0	0	0	0
0	3.375	0	3.375
0	6.75	0	6.75
0	10.125	0	10.125
0	13.5	0	13.5
0	16.875	0	16.875
0	23.875	0	23.875
0	27.25	0	27.25
0	30.625	0	30.625
0	34	0	34
0	37.375	0	37.375
0	40.75	0	40.75
2.875	0	3	0
2.875	3.375	3	3.375
2.875	6.75	3	6.75
2.875	10.125	3	10.125
2.875	13.5	3	13.5
2.875	16.875	3	16.875
2.875	23.875	3	23.875
2.875	27.25	3	27.25
2.875	30.625	3	30.625
2.875	34	3	34
2.875	37.375	3	37.375
2.875	40.75	3	40.75
5.75	0	6	0
5.75	3.375	6	3.375
5.75	6.75	6	6.75
5.75	10.125	6	10.125
5.75	13.5	6	13.5
5.75	16.875	6	16.875
5.75	23.875	6	23.875
5.75	27.25	6	27.25
5.75	30.625	6	30.625
5.75	34	6	34
5.75	37.375	6	37.375
5.75	40.75	6	40.75
8.625	0	9	0
8.625	3.375	9	3.375
8.625	6.75	9	6.75
8.625	10.125	9	10.125
8.625	13.5	9	13.5
8.625	16.875	9	16.875
8.625	23.875	9	23.875
8.625	27.25	9	27.25
8.625	30.625	9	30.625
8.625	34	9	34
8.625	37.375	9	37.375
8.625	40.75	9	40.75
11.5	0	12	0
11.5	3.375	12	3.375
11.5	6.75	12	6.75
11.5	10.125	12	10.125
11.5	13.5	12	13.5
11.5	16.875	12	16.875
11.5	23.875	12	23.875
11.5	27.25	12	27.25
11.5	30.625	12	30.625
11.5	34	12	34
11.5	37.375	12	37.375

	Top Flange		Bottom Flange	
No. Bolts =	192.0		132.0	
Splice Plate to First Column (in) =	2.000	OK	2.000	OK
No. Longitudinal Space =	15.0		10.0	
Longitudinal Spacing (in) =	2.875	NG	3.000	OK
Last Column to End Girder (in) =	2.000	OK	2.000	OK
Gap (in) =	0.500		0.500	
Edge Flange to First Row (in) =	2.125	OK	2.125	OK
No. Trans Space (per side of web) =	5.0		5.0	
Transverse Spacing (in) =	3.375	OK	3.375	OK
Center Row to CL Web (in) =	3.500		3.500	
Bolt Stagger =	NO		NO	





11.5	40.75	12	40.75
14.375	0	15	0
14.375	3.375	15	3.375
14.375	6.75	15	6.75
14.375	10.125	15	10.125
14.375	13.5	15	13.5
14.375	16.875	15	16.875
14.375	23.875	15	23.875
14.375	27.25	15	27.25
14.375	30.625	15	30.625
14.375	34	15	34
14.375	37.375	15	37.375
14.375	40.75	15	40.75
17.25	0	18	0
17.25	3.375	18	3.375
17.25	6.75	18	6.75
17.25	10.125	18	10.125
17.25	13.5	18	13.5
17.25	16.875	18	16.875
17.25	23.875	18	23.875
17.25	27.25	18	27.25
17.25	30.625	18	30.625
17.25	34	18	34
17.25	37.375	18	37.375
17.25	40.75	18	40.75
20.125	0	21	0
20.125	3.375	21	3.375
20.125	6.75	21	6.75
20.125	10.125	21	10.125
20.125	13.5	21	13.5
20.125	16.875	21	16.875
20.125	23.875	21	23.875
20.125	27.25	21	27.25
20.125	30.625	21	30.625
20.125	34	21	34
20.125	37.375	21	37.375
20.125	40.75	21	40.75
23	0	24	0
23	3.375	24	3.375
23	6.75	24	6.75
23	10.125	24	10.125
23	13.5	24	13.5
23	16.875	24	16.875
23	23.875	24	23.875
23	27.25	24	27.25
23	30.625	24	30.625
23	34	24	34
23	37.375	24	37.375
23	40.75	24	40.75
25.875	0	27	0
25.875	3.375	27	3.375
25.875	6.75	27	6.75
25.875	10.125	27	10.125
25.875	13.5	27	13.5
25.875	16.875	27	16.875
25.875	23.875	27	23.875
25.875	27.25	27	27.25
25.875	30.625	27	30.625
25.875	34	27	34
25.875	37.375	27	37.375
25.875	40.75	27	40.75
28.75	0	30	0
28.75	3.375	30	3.375
28.75	6.75	30	6.75
28.75	10.125	30	10.125
28.75	13.5	30	13.5

Flange Bolt Pattern Cont. - Node 3556

28.75	16.875	30	16.875
28.75	23.875	30	23.875
28.75	27.25	30	27.25
28.75	30.625	30	30.625
28.75	34	30	34
28.75	37.375	30	37.375
28.75	40.75	30	40.75
31.625	0		
31.625	3.375		
31.625	6.75		
31.625	10.125		
31.625	13.5		
31.625	16.875		
31.625	23.875		
31.625	27.25		
31.625	30.625		
31.625	34		
31.625	37.375		
31.625	40.75		
34.5	0		
34.5	3.375		
34.5	6.75		
34.5	10.125		
34.5	13.5		
34.5	16.875		
34.5	23.875		
34.5	27.25		
34.5	30.625		
34.5	34		
34.5	37.375		
34.5	40.75		
37.375	0		
37.375	3.375		
37.375	6.75		
37.375	10.125		
37.375	13.5		
37.375	16.875		
37.375	23.875		
37.375	27.25		
37.375	30.625		
37.375	34		
37.375	37.375		
37.375	40.75		
40.25	0		
40.25	3.375		
40.25	6.75		
40.25	10.125		
40.25	13.5		
40.25	16.875		
40.25	23.875		
40.25	27.25		
40.25	30.625		
40.25	34		
40.25	37.375		
40.25	40.75		
43.125	0		
43.125	3.375		
43.125	6.75		
43.125	10.125		
43.125	13.5		
43.125	16.875		
43.125	23.875		
43.125	27.25		
43.125	30.625		
43.125	34		
43.125	37.375		

Flange Bolt Pattern Cont. - Node

HNTB	The HNTB Companies Engineers Architects Planners	Made	SAE	Date	6/10/2011	Job Number	49633
		Checked	MCC	Date	6/10/2011		
For	Cleveland InnerBelt : Field Splice - Node 3556	Backchk'd	SAE	Date	6/10/2011	Sheet No.	

43.125	40.75		

Flange Bolt Pattern Cont. - Node 3556

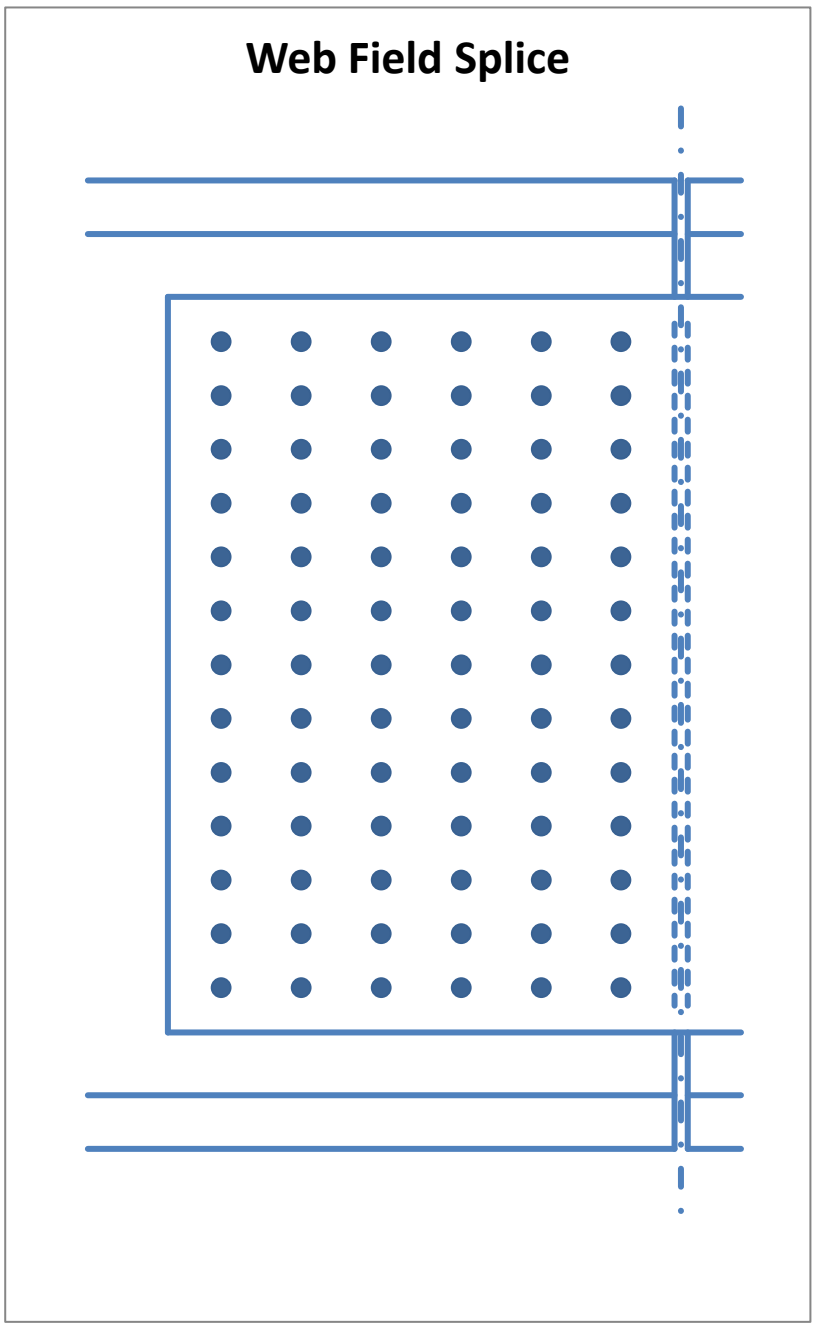
HNTB	The HNTB Companies Engineers Architects Planners	Made	SAE	Date	6/10/2011	Job Number	49633
		Checked	MCC	Date	6/10/2011		
For	Cleveland InnerBelt : Field Splice - Node 3556	Backchk'd	SAE	Date	6/10/2011	Sheet No.	

Web Bolt Pattern - Node 3556

Note: Hole shift is constant for all bolts. Values computed in this geometry worksheet don't change relative to the origin (i.e. lower left bolt in pattern). Computed centroid can be adjusted in Type N worksheet as needed.

Bolt Coordinates (in)			
x (long)	y (vert)	$(x-x_{bar})^2$	$(y-y_{bar})^2$
0	0	56.25	324
0	3	56.25	225
0	6	56.25	144
0	9	56.25	81
0	12	56.25	36
0	15	56.25	9
0	18	56.25	0
0	21	56.25	9
0	24	56.25	36
0	27	56.25	81
0	30	56.25	144
0	33	56.25	225
0	36	56.25	324
3	0	20.25	324
3	3	20.25	225
3	6	20.25	144
3	9	20.25	81
3	12	20.25	36
3	15	20.25	9
3	18	20.25	0
3	21	20.25	9
3	24	20.25	36
3	27	20.25	81
3	30	20.25	144
3	33	20.25	225
3	36	20.25	324
6	0	2.25	324
6	3	2.25	225
6	6	2.25	144
6	9	2.25	81
6	12	2.25	36
6	15	2.25	9
6	18	2.25	0
6	21	2.25	9
6	24	2.25	36
6	27	2.25	81
6	30	2.25	144
6	33	2.25	225
6	36	2.25	324
9	0	2.25	324
9	3	2.25	225
9	6	2.25	144
9	9	2.25	81
9	12	2.25	36
9	15	2.25	9
9	18	2.25	0
9	21	2.25	9
9	24	2.25	36
9	27	2.25	81
9	30	2.25	144
9	33	2.25	225
9	36	2.25	324
12	0	20.25	324
12	3	20.25	225
12	6	20.25	144
12	9	20.25	81
12	12	20.25	36
12	15	20.25	9
12	18	20.25	0

No. Bolts =	78.0	
Splice Plate to First Column (in) =	2.0	OK
No. Longitudinal Space =	5.0	
Longitudinal Spacing (in) =	3.000	OK
Last Column to End Girder (in) =	2.000	OK
Gap (in) =	0.500	
Top/Bot Web to First Row (in) =	6.000	OK
Splice Plate to First Row (in) =	2.500	OK
No. Vertical Space =	12.0	
Vertical Spacing (in) =	3.000	OK
Bolt Stagger =	NO	
x_{bar} (in) =	7.5	
y_{bar} (in) =	18	
$\Sigma(x\text{-}xbar)^2$ (in^2)=	2047.5	
$\Sigma(y\text{-}ybar)^2$ (in^2) =	9828	
Σd^2 (in^2) =	11875.5	



HNTB	The HNTB Companies Engineers Architects Planners	Made	SAE	Date	6/10/2011	Job Number	49633
		Checked	MCC	Date	6/10/2011		
For	Cleveland InnerBelt : Field Splice - Node 3556	Backchk'd	SAE	Date	6/10/2011	Sheet No.	

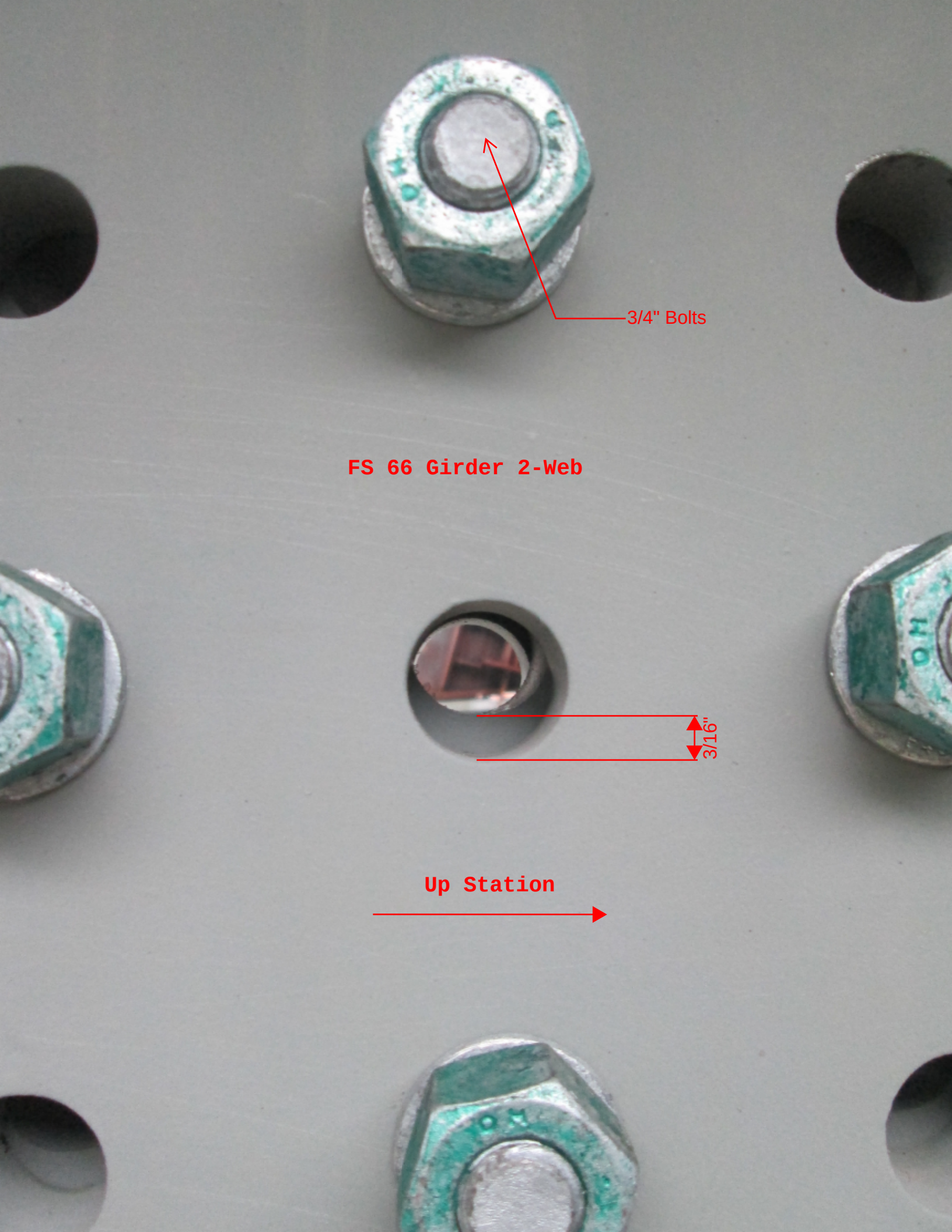
12	21	20.25	9
12	24	20.25	36
12	27	20.25	81
12	30	20.25	144
12	33	20.25	225
12	36	20.25	324
15	0	56.25	324
15	3	56.25	225
15	6	56.25	144
15	9	56.25	81
15	12	56.25	36
15	15	56.25	9
15	18	56.25	0
15	21	56.25	9
15	24	56.25	36
15	27	56.25	81
15	30	56.25	144
15	33	56.25	225
15	36	56.25	324

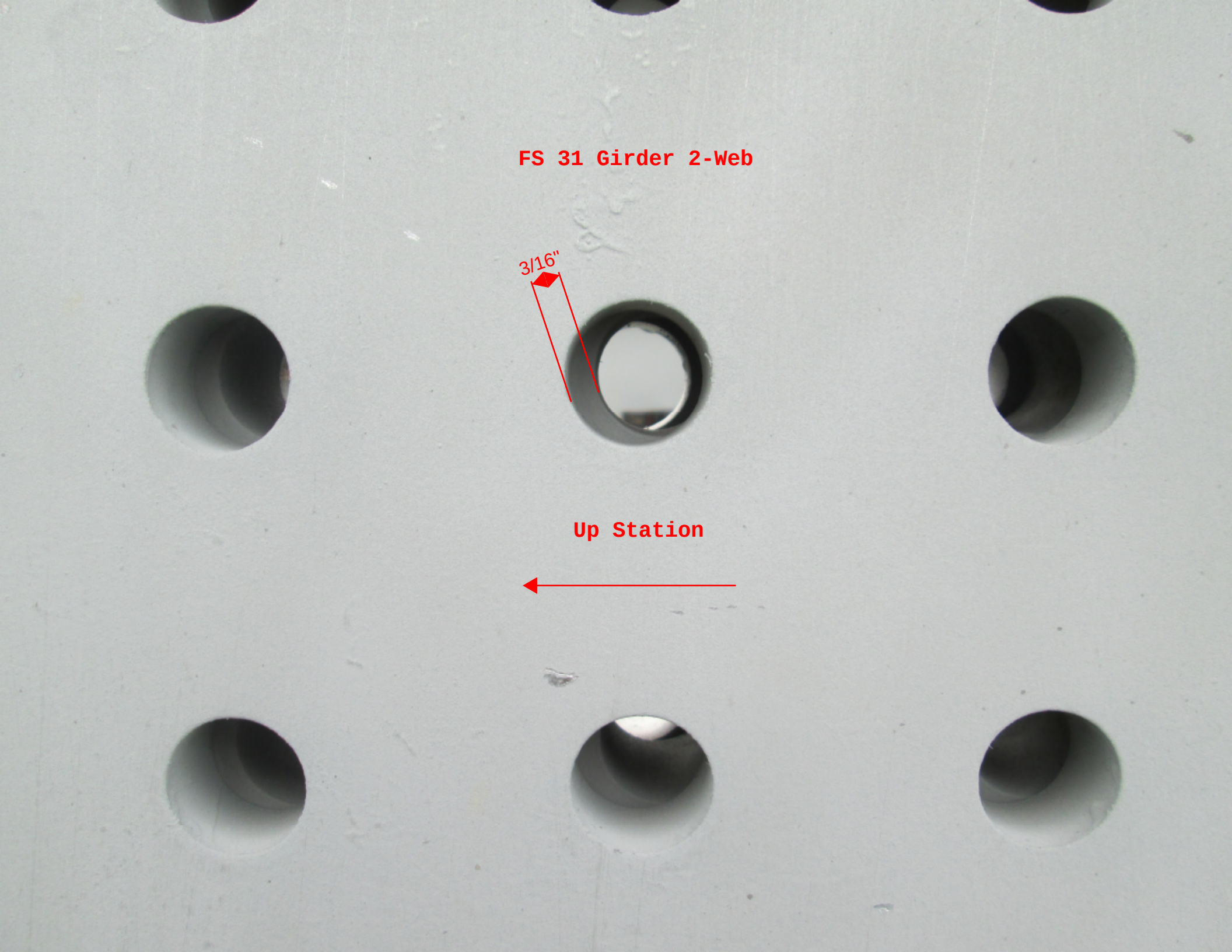
Web Bolt Pattern Cont. - Node 3556

HNTB	The HNTB Companies Engineers Architects Planners	Made	SAE	Date	6/10/2011	Job Number	49633
		Checked	MCC	Date	6/10/2011		
For	Cleveland InnerBelt : Field Splice - Node 3556	Backchk'd	SAE	Date	6/10/2011	Sheet No.	

Web Bolt Pattern Cont. - Node 3556

585	1404	2047.5	9828


3/4" Bolts
FS 66 Girder 2-Web
3/16"
Up Station


FS 31 Girder 2-Web
3/16"
Up Station