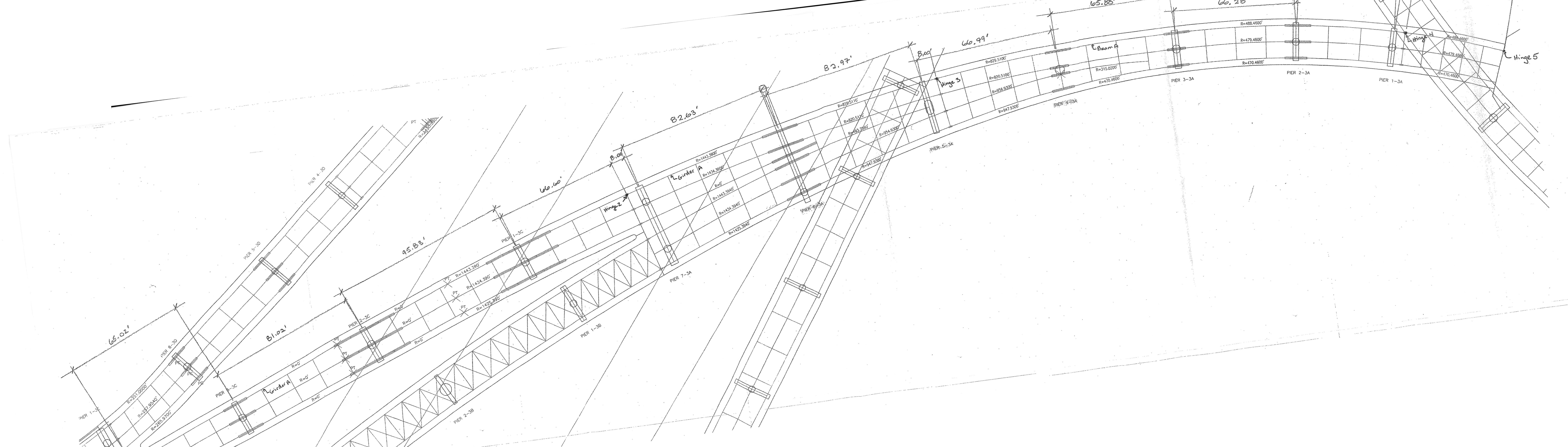
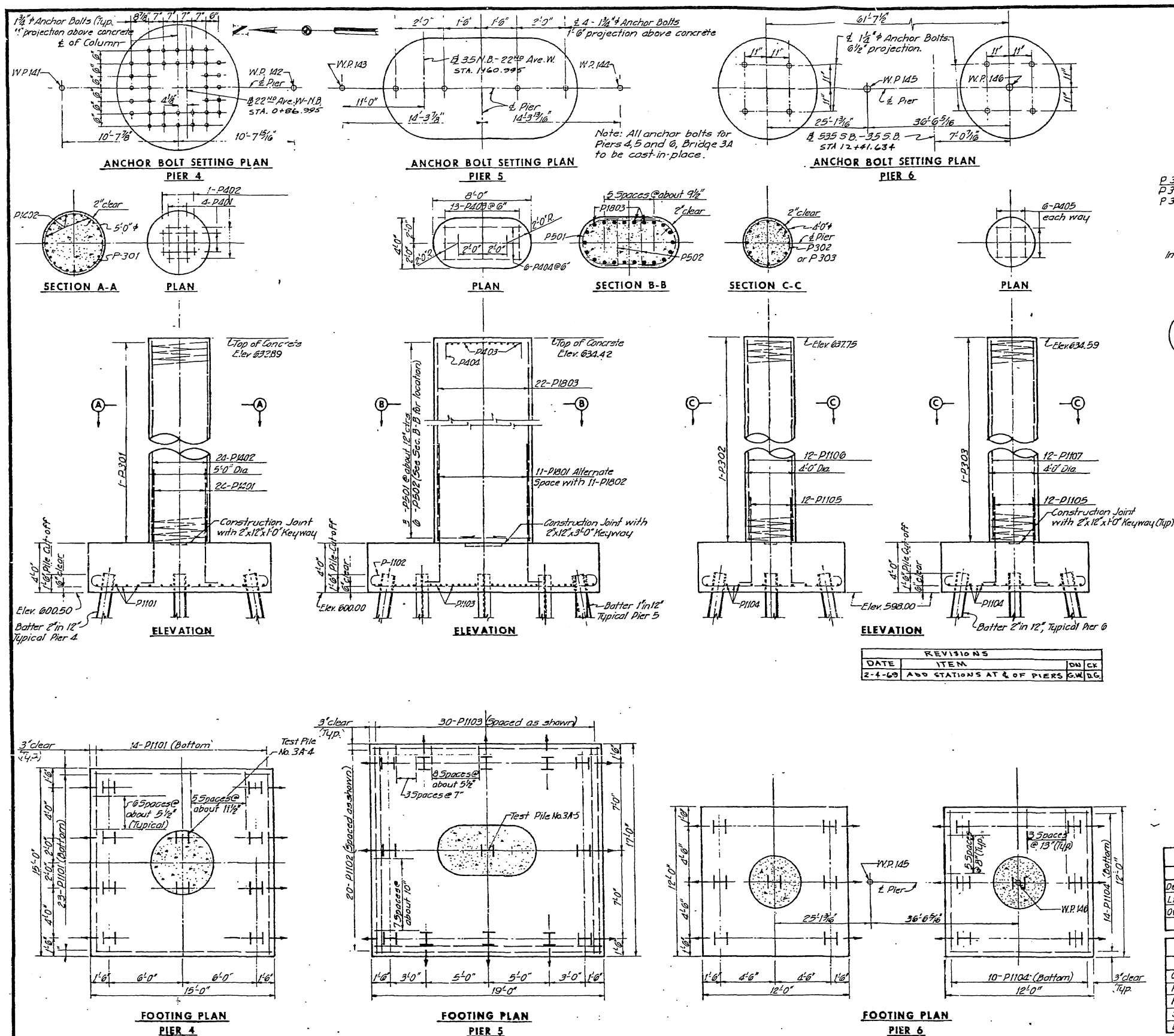




3C-3A GIRDER MODEL



BILL OF REINFORCEMENT							
BAR	NO.	SIZE	LENGTH	TYPE	DIMENSIONS		LOCATION
					A	B	
PIER 4							
P401	8	4	7'-0"	103	4'-0"	1'-6"	Column
P402	4	4	6'-0"	103	3'-0"	1'-6"	Column
P501	1	3		123	28'-2"		Column
P1101	37	11	17'-8"	100	14'-6"		Footing
P1401	24	14	10'-6"	104	9'-5"	1'-0"	Footing
P1402	24	14	28'-2"	Str.			Column
PIER 5							
P403	13	4	5'-9"	103	2'-9"	1'-6"	Column
P404	6	4	9'-3"	103	6'-3"	1'-6"	Column
P501	31	5	23'-1"	180			Column
P502	62	5	5'-8"	103	3'-8"	1'-0"	Column
P1102	20	11	21'-8"	100	18'-6"		Footing
P1103	30	11	19'-8"	100	16'-6"		Footing
P1801	11	18	11'-6"	104	10'-6"	1'-0"	Footing
P1802	11	18	12'-6"	104	11'-6"	1'-0"	Footing
P1803	22	18	30'-2"	Str.			Column
PIER 6							
P405	24	4	5'-6"	103	2'-6"	1'-6"	Column
P502	1	3		123	35'-7"		Column
P303	1	3		123	32'-4"		Column
P1104	48	11	14'-8"	100	11'-6"		Footing
P1105	24	11	8'-0"	104	7'-0"	1'-0"	Footing
P1106	12	11	35'-7"	Str.			Column
P1107	12	11	32'-4"	Str.			Column

PILE DATA			
Pile Type	No. and Estim. Length		
	Pier 4	Pier 5	Pier 6
12AP53	9 @ 125'	13 @ 125'	14 @ 125'
12AP53 Test Pile	1 @ 135'	1 @ 135'	

QUANTITIES				
Item	Unit	Pier 4	Pier 5	Pier
Excavation Class UE	Cu. Yd.	72	96	103
Concrete Mix 1A6	Cu. Yd.	33	48	43
Concrete Mix 3Y6	Cu. Yd.	21	32	32
Reinforcement Bars	Lbs.	10,995	19,021	10,043
12 BP 53 Delivered ①	Lbs.	59,625	86,130	92,750
12 BP 53 Test Piles in Place 135' Long.	Each	1	1	
Bridge Ground ②	No.			1

COMPUTED PILE LOADS-TONS/PILE			
Load	Pier 4	Pier 5	Pier 6
Dead Load	25	16	35
Live Load	4	8	7
Overturning	36	31	25
Total	65	55	67

SPIRAL DATA			
Bar	P301	P302	P303
Outside Dia.	4'-8"	3'-8"	3'-8"
Height	28'-2"	35'-7"	32'-4"
Pitch	6"	6"	6"
Spiral rod size	3" ϕ	3" ϕ	3" ϕ
Estimated Weight	328	321	294

H.N.T.B. BR. NO. 2A, 2C-2K, 3A-3E

TRUNK HIGHWAY NO. 35
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS

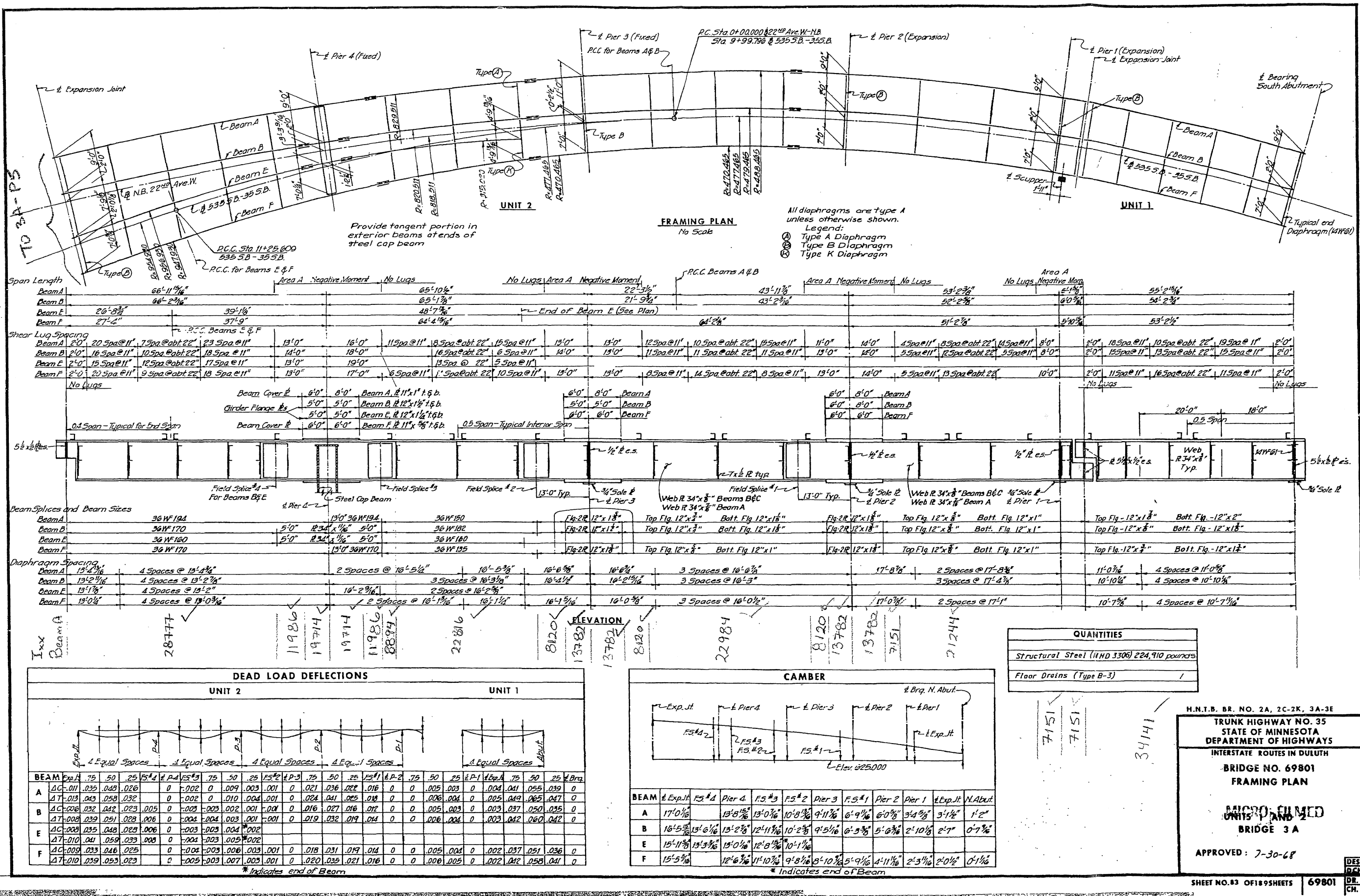
INTERSTATE ROUTES IN DULUTH

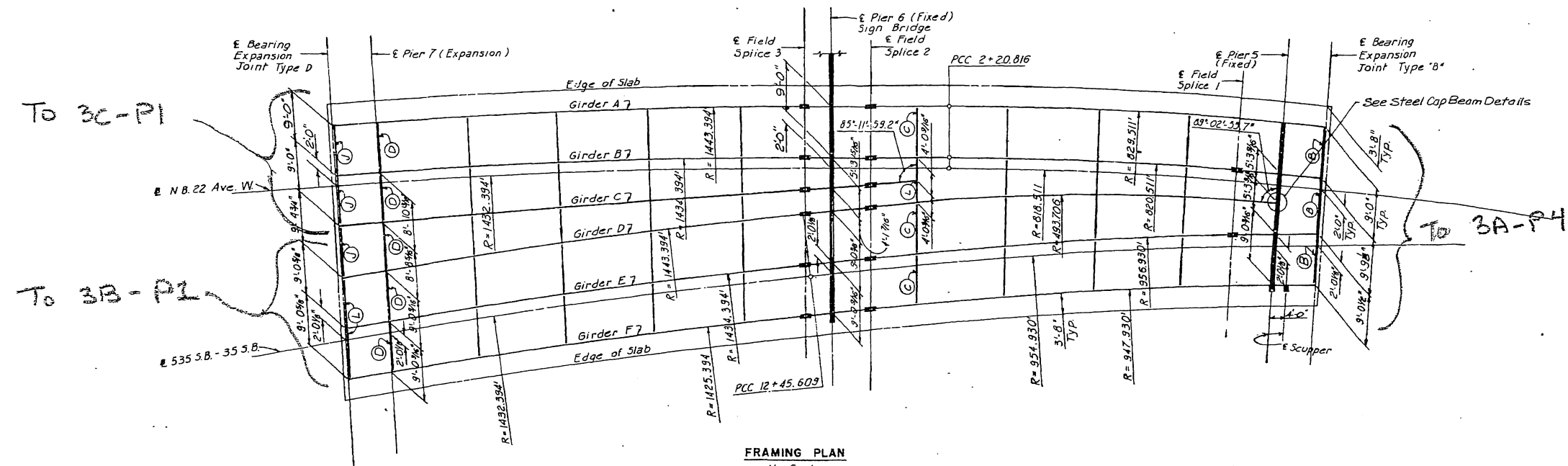
BRIDGE NO. 69801

PIERS 4, 5, AND 6

MICRO-FILM
BRIDGE 3A

REVISED 2-4-69
APPROVED: 7-30-68





All Diaphragms are Type C unless otherwise noted.

Legend

(B) Diaphragm Type B

(D) Diaphragm Type D

(L) Diaphragm Type L

(J) Diaphragm Type J

DEAD LOAD DEFLECTIONS													
		GIRDER											
		EJ	P7	25	50	75	PS	25	50	75	PS	EJ	
F51	ΔC	-.016	0	.040	.050	.023	0	.022	.046	.036	0	-.011	
	ΔT	-.007	0	.043	.057	.031	0	.009	.026	.022	0	-.006	
	ΔT	-.007	0	.043	.057	.031	0	.009	.026	.022	0	-.006	
F52	ΔC	-.014	0	.042	.056	.030	0	.003*					
	ΔT	-.017	0	.051	.068	.036	0	.007*					
	ΔT	-.017	0	.051	.068	.036	0	.007*					
F53	ΔC	-.014	0	.040	.054	.028	0	.012	.037	.034	0	-.010	
	ΔT	-.017	0	.050	.066	.035	0	.015	.046	.043	0	-.013	
	ΔT	-.017	0	.050	.066	.035	0	.015	.046	.043	0	-.013	
F54	ΔC	-.013	0	.037	.048	.024	0	.016	.035	.027	0	-.008	
	ΔT	-.016	0	.045	.058	.029	0	.020	.043	.034	0	-.010	
	ΔT	-.016	0	.045	.058	.029	0	.020	.043	.034	0	-.010	
F55	ΔC	-.013	0	.039	.050	.024	0	.018	.040	.031	0	-.009	
	ΔT	-.016	0	.046	.060	.029	0	.022	.048	.037	0	-.011	
	ΔT	-.016	0	.046	.060	.029	0	.022	.048	.037	0	-.011	

* indicates end of girder

CAMBER DIAGRAM													
		GIRDER											
		1	2	3	4	5	6	7	8	9	10	11	12
A	ΔC	6'-18"	5'-13"	5'-11"	5'-8"	5'-4"	5'-0"	4'-11"	4'-10"	4'-5"	3'-10"	3'-2"	2'-4"
	ΔT	5'-33"	5'-8"	5'-6"	5'-3"	4'-11"	4'-7"	4'-6"	4'-4"	3'-11"	3'-4"	2'-7"	2'-0"
	ΔT	5'-33"	5'-8"	5'-6"	5'-3"	4'-11"	4'-7"	4'-6"	4'-4"	3'-11"	3'-4"	2'-7"	2'-0"
B	ΔC	5'-43"	5'-4"	5'-2"	4'-11"	4'-7"	4'-3"	4'-2"	4'-1"	3'-10"	3'-0"	2'-4"	1'-6"
	ΔT	5'-03"	4'-11"	4'-10"	4'-7"	4'-4"	4'-1"	3'-11"	3'-6"	3'-0"	2'-4"	1'-6"	0'-8"
	ΔT	5'-03"	4'-11"	4'-10"	4'-7"	4'-4"	4'-1"	3'-11"	3'-6"	3'-0"	2'-4"	1'-6"	0'-8"
C	ΔC	4'-79"	4'-73"	4'-59"	4'-27"	3'-11"	3'-7"	3'-6"	3'-5"	3'-13"	2'-6"	1'-11"	0'-11"
	ΔT	4'-37"	4'-27"	4'-0"	3'-9"	3'-6"	3'-2"	3'-1"	2'-11"	2'-7"	2'-0"	1'-5"	0'-8"
	ΔT	4'-37"	4'-27"	4'-0"	3'-9"	3'-6"	3'-2"	3'-1"	2'-11"	2'-7"	2'-0"	1'-5"	0'-8"

* indicates end of girder

H.N.T.B. BR. NO. 2A, 2C-2K, 3A-3E

TRUNK HIGHWAY NO. 35
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS

INTERSTATE ROUTES IN DULUTH

BRIDGE NO. 69801

FRAMING PLAN

CAMBER AND DEFLECTION
DIAGRAMS

MINN. FILMED

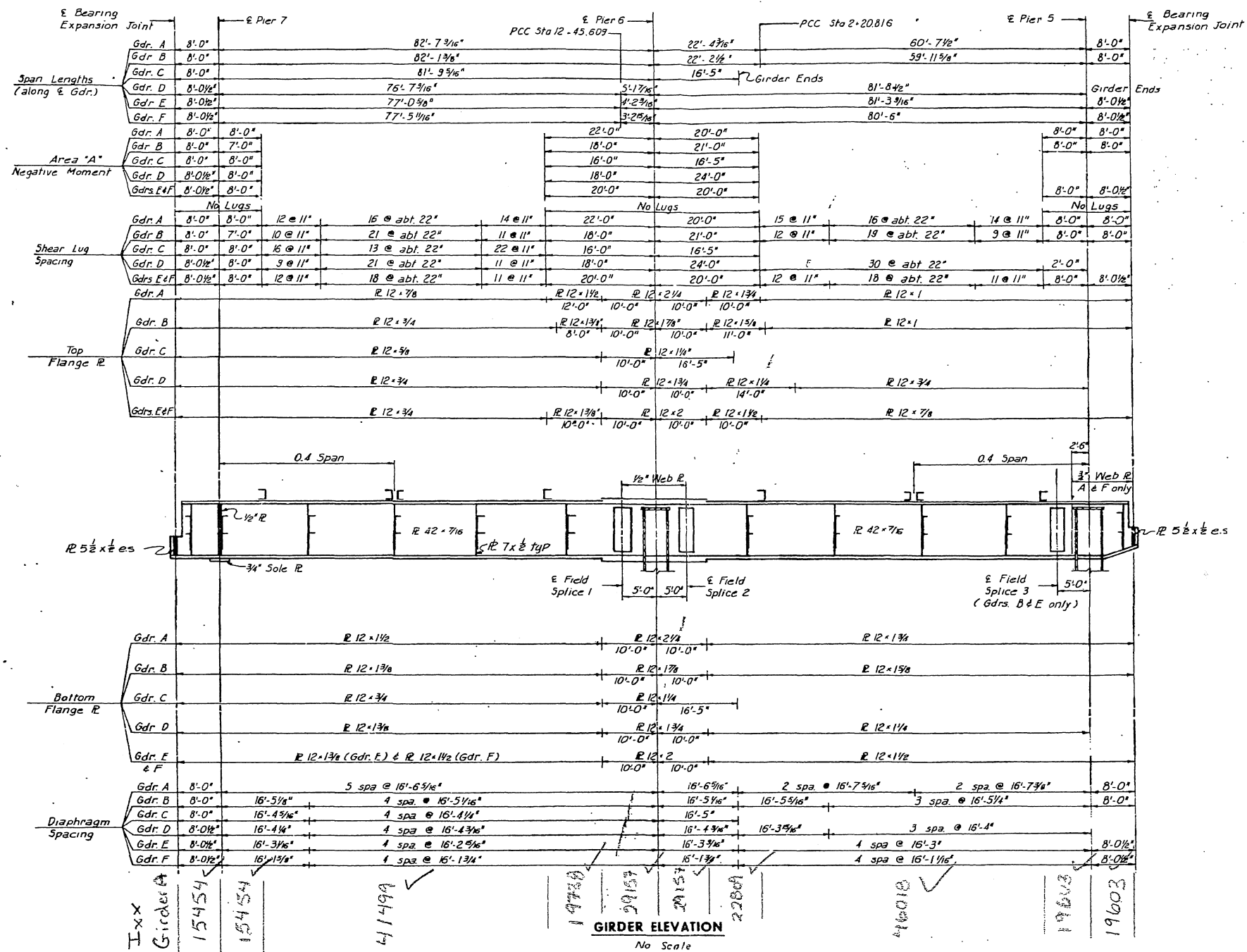
BRIDGE 3A

APPROVED: 7-30-68

DES: DLM
CHK: LFP
CH: DLM

SHEET NO. 84 OF 189 SHEETS 69801

I-4



SUMMARY OF QUANTITIES - BRIDGE 3A UNIT 3	
Structural Steel (MHD 330C)	299,050 pounds
Floor Drains (Type B3)	2
Bearing Assemblies (Type SF1)	2 Units

H.N.T.B. BR. NO. 2A, 2C-2K, 3A-3E

TRUNK HIGHWAY NO. 35
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS
INTERSTATE ROUTES IN DULUTH

BRIDGE NO. 69801

GIRDER ELEVATION

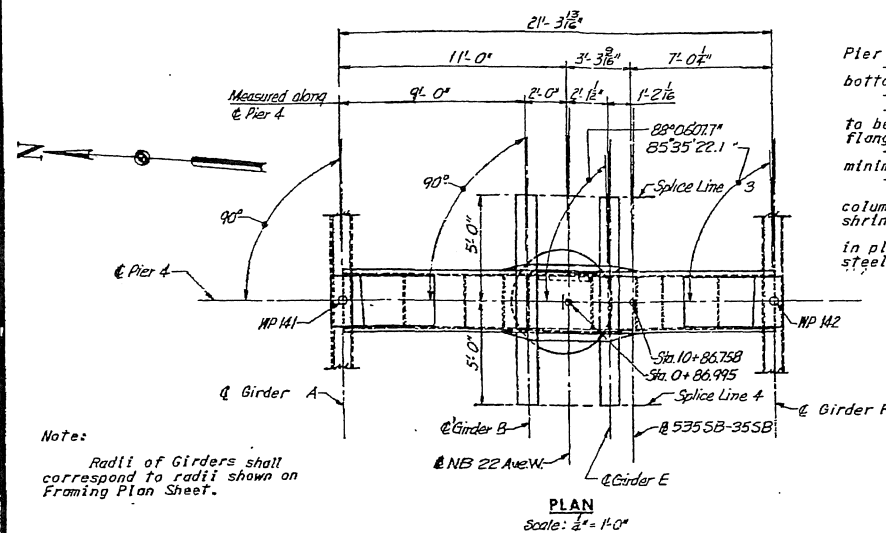
UNIT 3

BRIDGE 3A

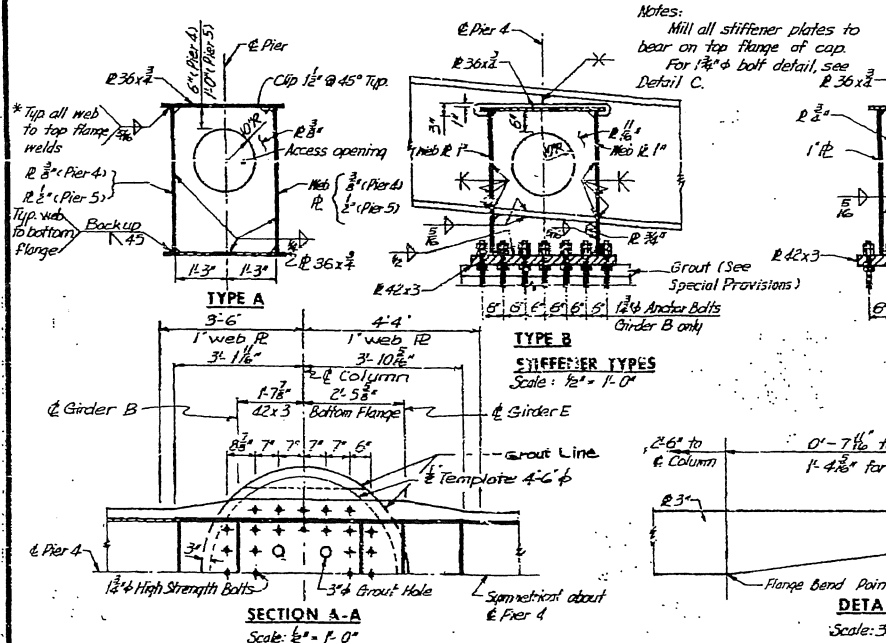
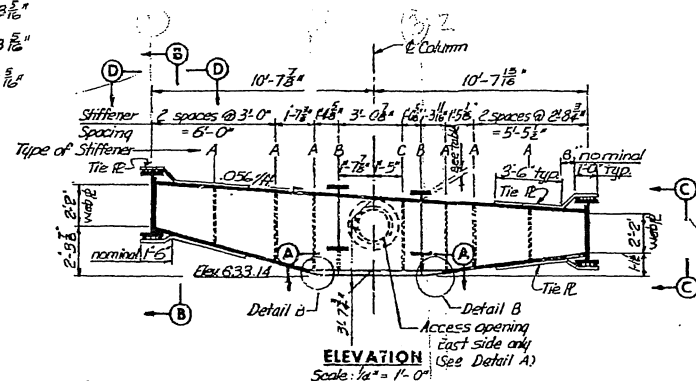
APPROVED: **WCR FILMED**

SHEET NO. 85 OF 189 SHEETS 69801

DES. 127
SCH. 127
CH. 127

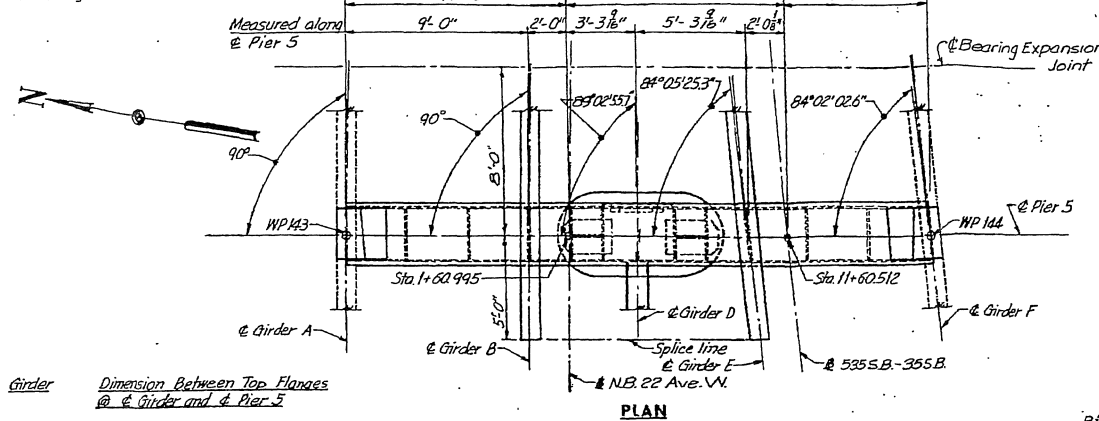


Girder	Dimension between Top Flanges @ Girder and Pier 4.
A	3 1/8"
B	3 1/8"
E	3 1/8"
F	3 1/8"

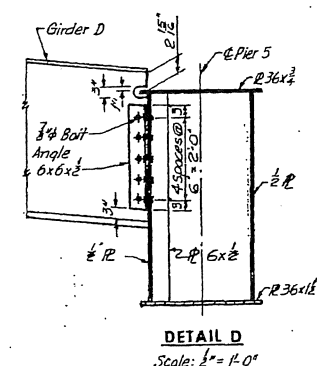
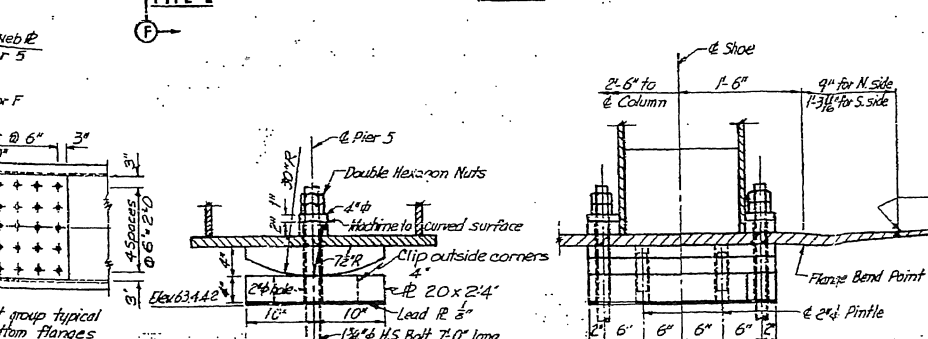
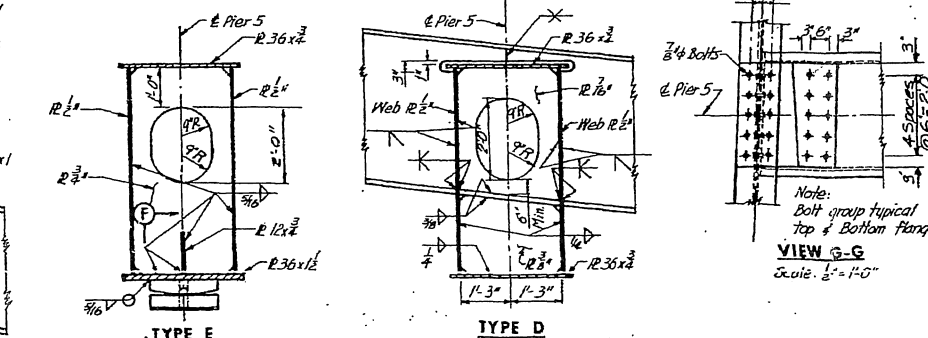
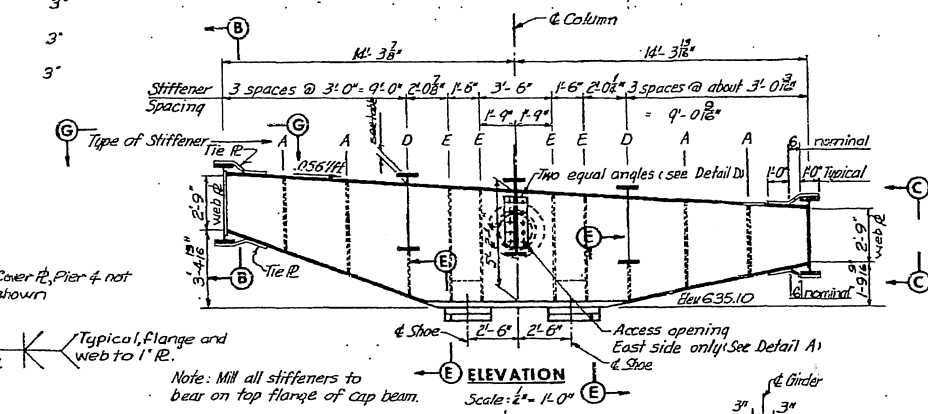
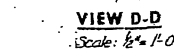
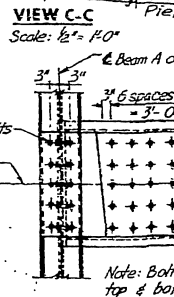
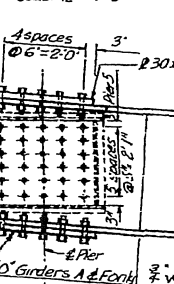
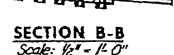
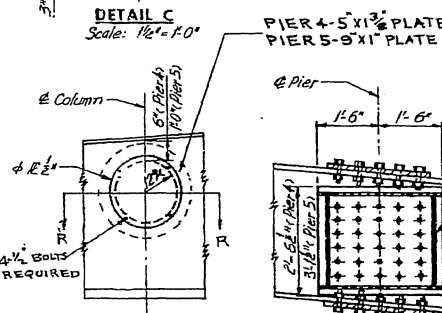
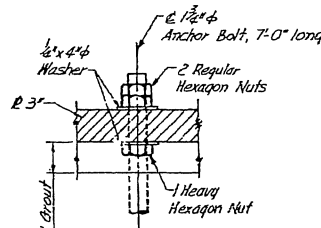


Notes:

Radii of Girders shall correspond to radii shown on Framing Plan Sheet.

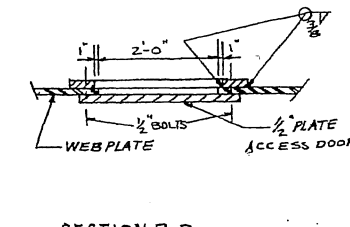


Girder	Dimension Between Top Flanges @ Girder and Pier 5
A	3"
B	3"
E	3"
F	3"



Pier 5 Cap Beam erection Procedure:
-position cap beam on shoes, tighten tie down nuts, complete superstructure concrete on adjacent spans, release tie down nuts, cover curved surfaces of tie down washers with heavy coating of grease, tighten tie down nuts to a minimum torque of 200 foot lb. Anchor bolts shall be held in position during concreting by a 2" steel template.

Notes:
For details of materials and finish not shown on shoes see Bearing Assembly Details.
For details of girder and beam sections not shown see Framing Plans.
Prior to placement of the deck concrete the entire area of the cap beam that will be in contact with the concrete shall be covered with a protective coating similar or equal to Koppers Company Bitumastic 50.
The deck slab shall be haunched to the top of the cap beam.
No dead load camber is required.



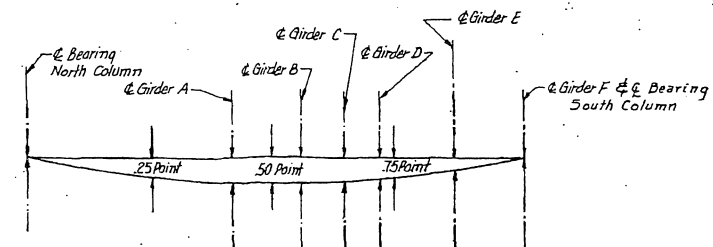
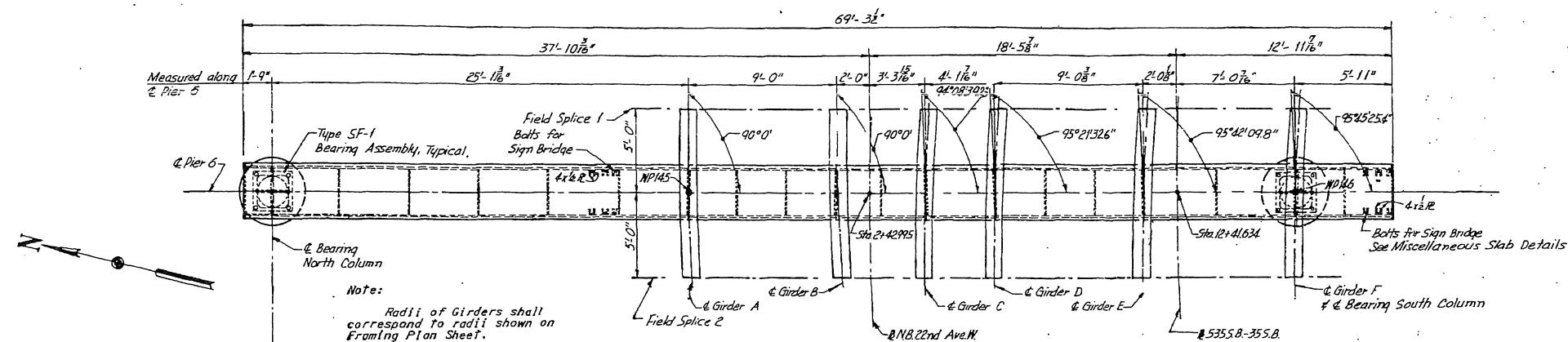
H.N.T.B. BR. NO. 2A, 2C-2K, 3A-3E
TRUNK HIGHWAY NO. 35
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS
INTERSTATE ROUTES IN DULUTH
BRIDGE NO. 69801

STEEL CAP BEAM DETAILS
PIER 4 AND PIER 5
BRIDGE 3A
APPROVED: 7-30-68

SHEET NO. 86 OF 189 SHEETS 69801

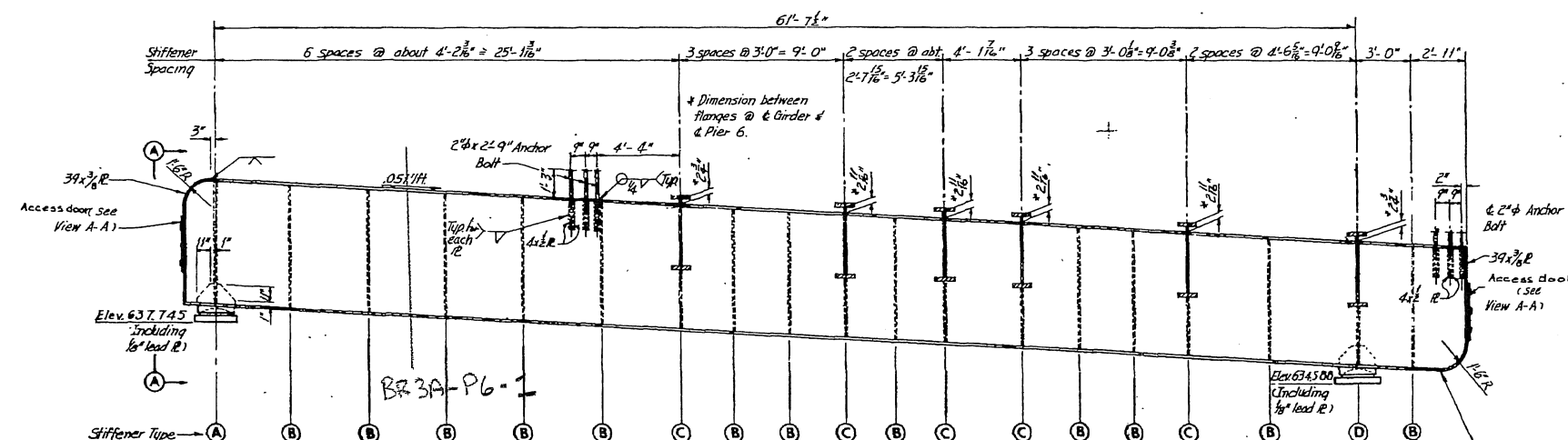
DES. JCK
CHK. JCK
APP. JCK
CH. JCK

I-6

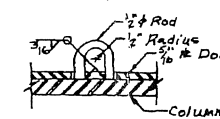
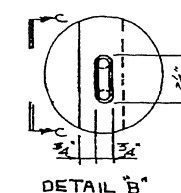


Deflection									
N. Brq.	.25 Pt.	Girder A	.50 Pt.	Girder B	Girder C	Girder D	.75 Pt.	Girder E	Girder S. Brq.
0	$\frac{3}{8}"$	$\frac{1}{2}"$	$\frac{1}{2}"$	$\frac{1}{2}"$	$\frac{1}{2}"$	$\frac{7}{8}"$	$\frac{3}{8}"$	$\frac{1}{4}"$	0

DEAD LOAD DEFLECTION DIAGRAM
No Scale

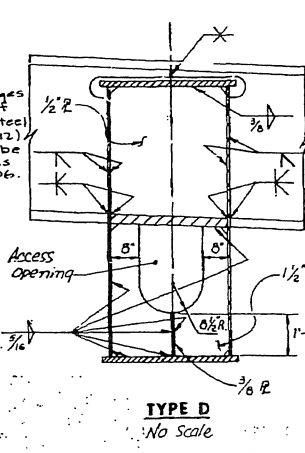
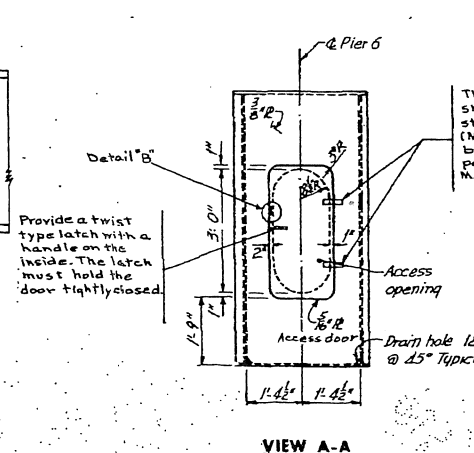
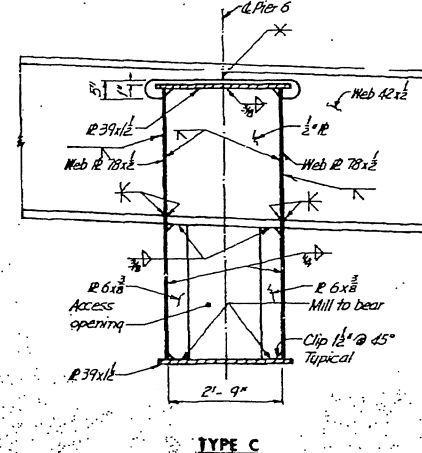
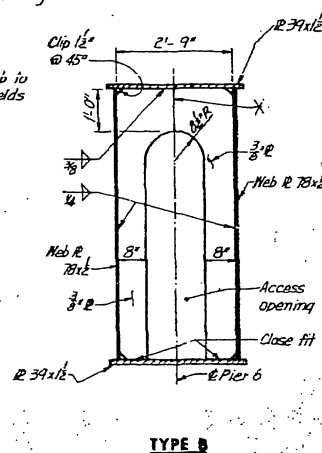
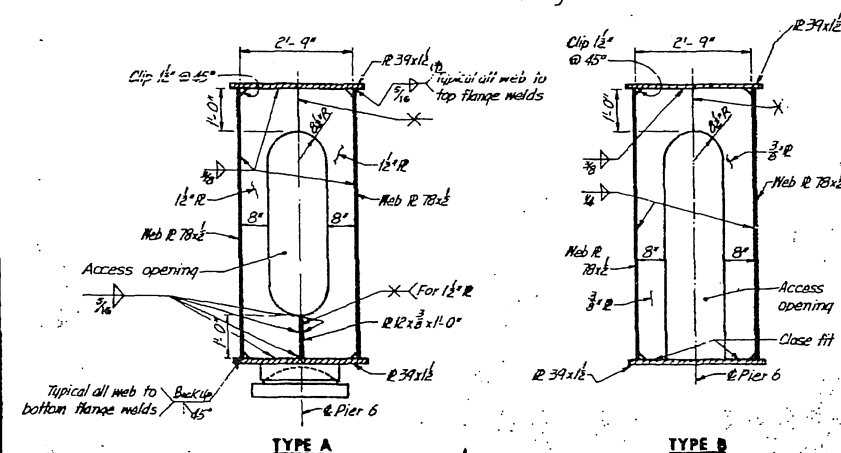


ELEVATION
Scale: $1'' = 1' - 0''$



Notes:

- For details of materials and finish not shown on shoes see Bearing Assembly Details.
- For details of girder and beam sections not shown see Framing Plans.
- Prior to placement of the deck concrete the entire area of the cap beam that will be in contact with the concrete shall be covered with a protective coating of oil or equal to Koppers Company Bitumastic 50.
- The deck slab shall be bunched to the top of the cap beam.
- The cap beam shall be cambered for dead load deflection.
- Anchor bolts shall be held in position during concreting by a 1" steel template.



TYPE D

STIFFENER TYPES

Scale: $\frac{1}{2}'' = 1' - 0''$

VIEW A-A
Scale: $\frac{1}{2}" = 1'-0"$

TYPE D
No Scale

H.N.T.B. BR. NO. 2A, 2C-2K, 3A-3E

TRUNK HIGHWAY NO. 35
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS

INTERSTATE ROUTES IN DULUTH

BRIDGE NO. 10001

BRIDGE NO. 69801

STEEL CAP BEAM DETAILS
PIER 6 BRIDGE 3A

1. *Journal of the American Medical Association*, 1997; 278: 1039-1044.

MICRO-FILMED

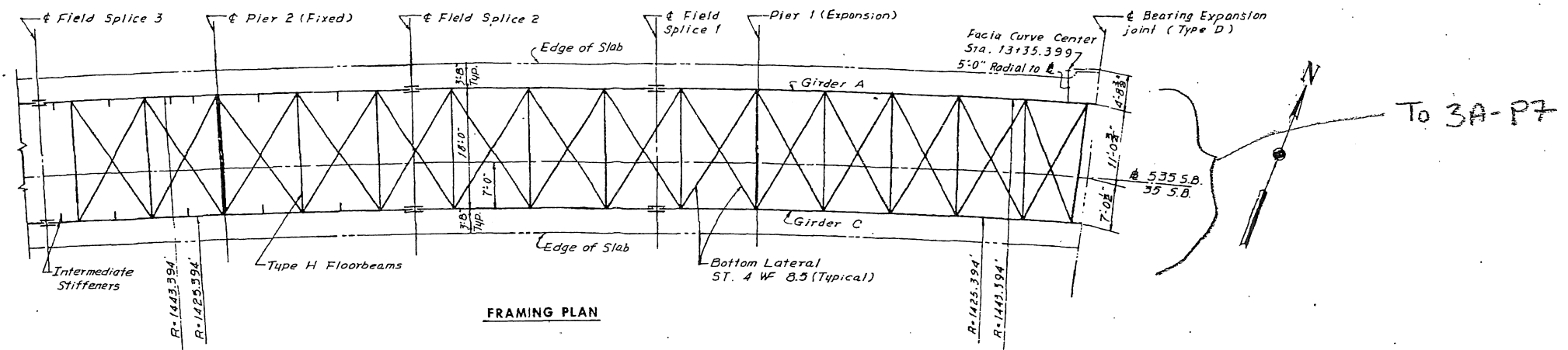
APPROVED: 7-30-68

SHEET NO. 87 OF 1895 SHEETS 69801

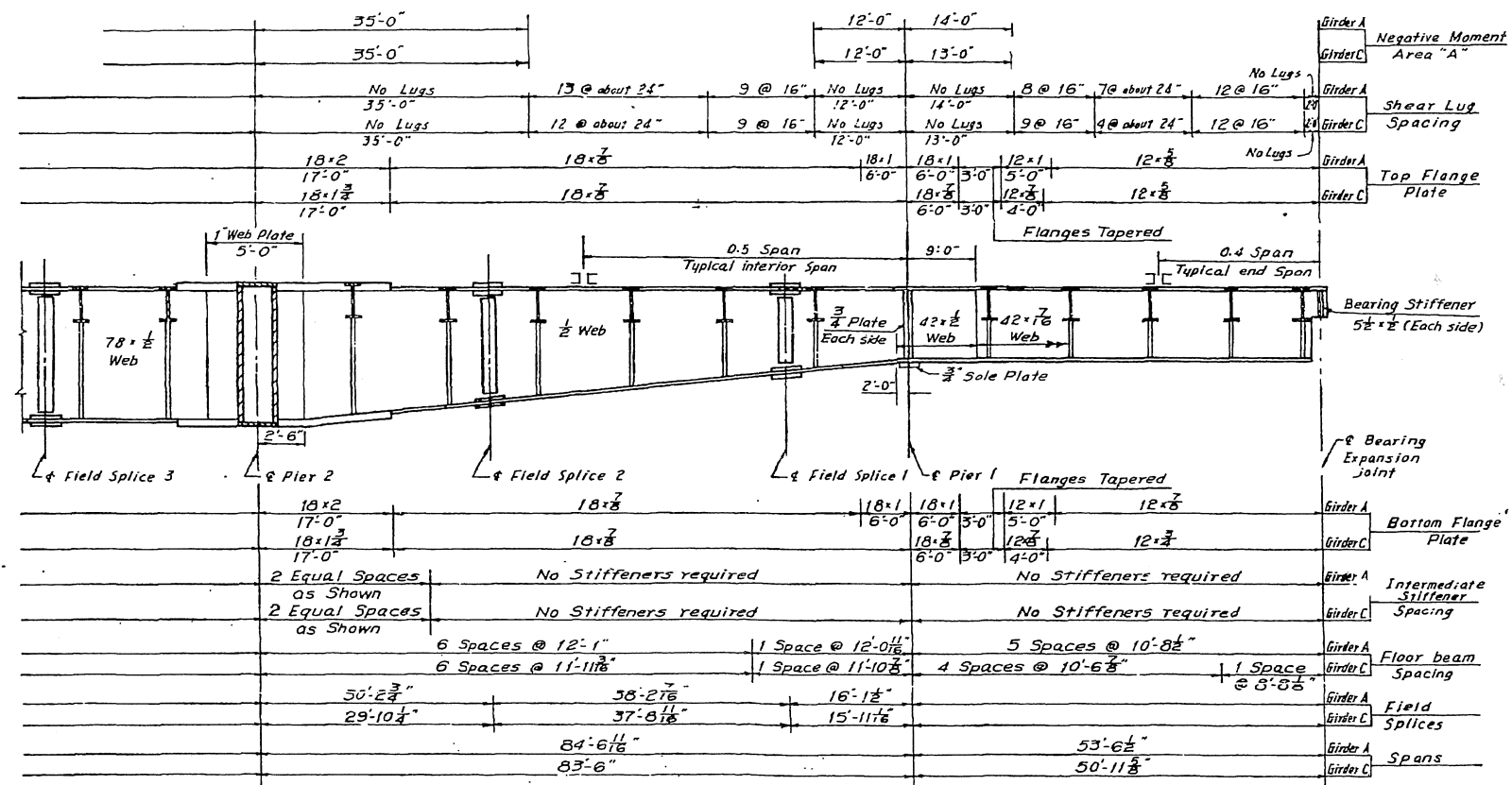
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DCH	PC
DR.	IC
CH.	PC

DR.	IT
CH.	P

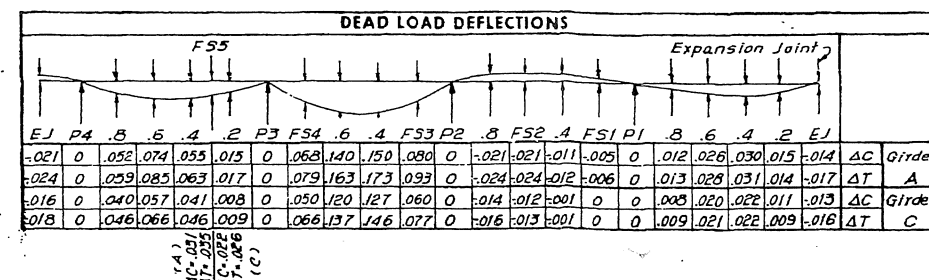
I-7



FRAMING PLAN



GIRDER ELEVATION



SUMMARY OF QUANTITIES	
UNIT 1 BRIDGE 3B	
Structural Steel (M.H.D. 3306, 325,350 pounds)	
Floor Drains (Type B-3)	1

H.N.T.B. BR. NO. 2A, 2C-2K, 3A-3E

TRUNK HIGHWAY NO. 35
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS

INTERSTATE ROUTES IN DULUTH

BRIDGE NO. 69801

FRAMING PLAN

UNIT 1
MICROFILMED
BRIDGE 3B

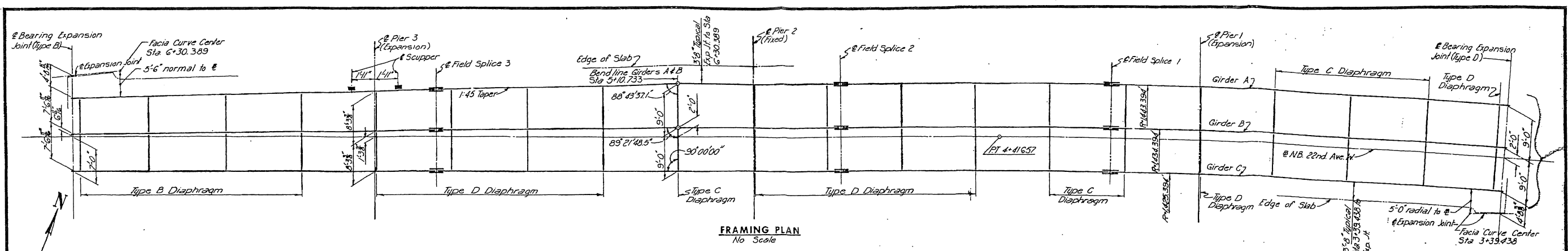
APPROVED: 7-30-68

SHEET NO. 88AOF189SHEETS

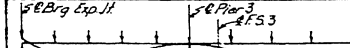
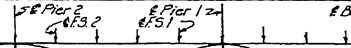
69801

DES. DUT
CHK. LEP
DR. J.S.M.
CH. DUT

✓JCM
5/6/10

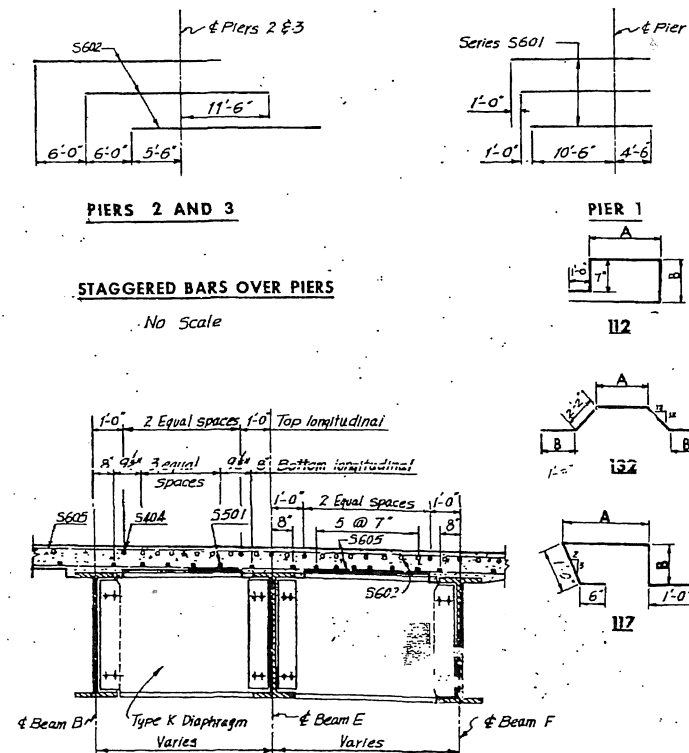
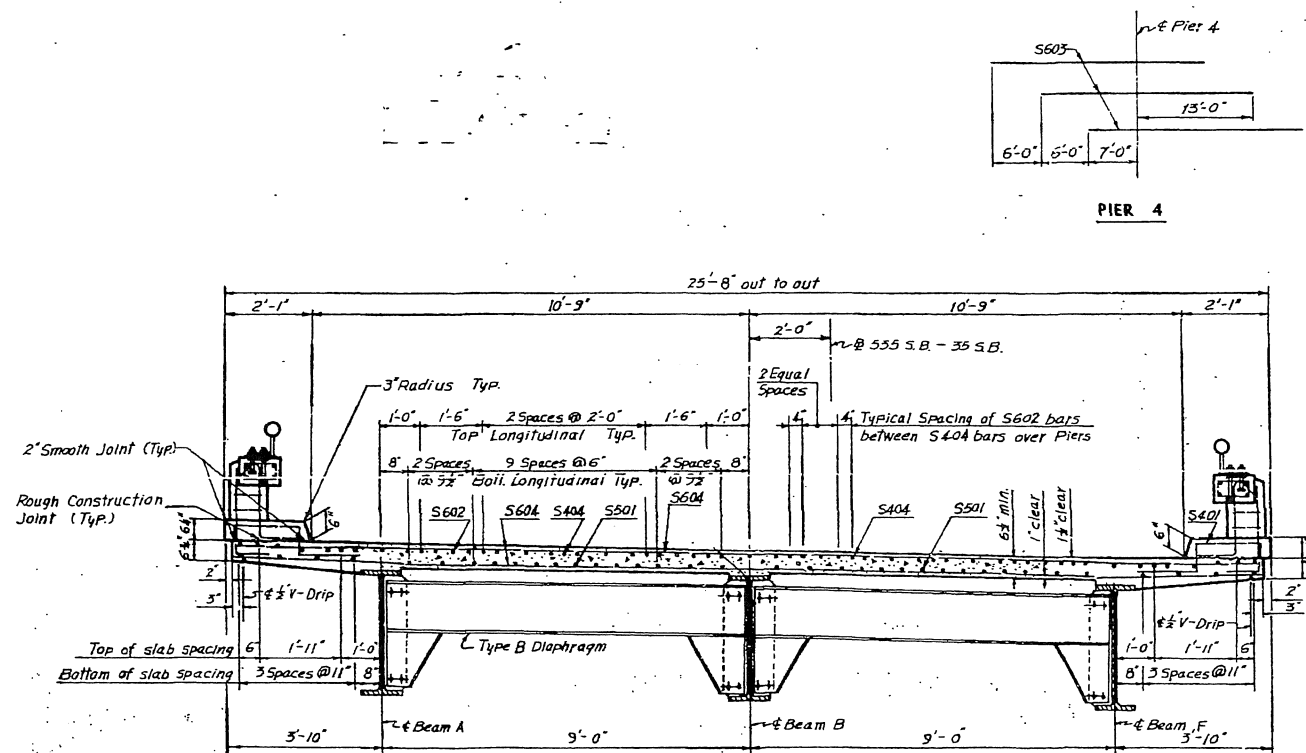
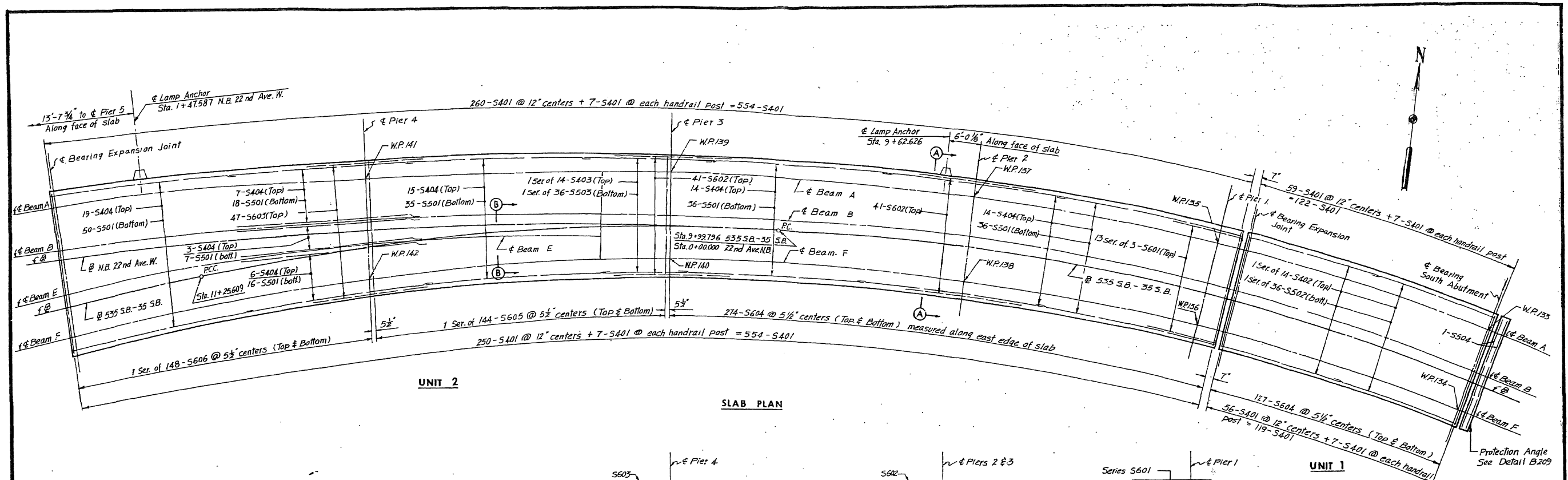


Span Lengths		65'-0"		81'-0"		95'-10"		66'-7 1/2"												
Shear Lug Spacing		A 20' 7@11"	19@about 22"	10@11"	13'-0"	16'-0"	6@11"	18@about 22"	5@11"	23'-0"	19'-0"	9@11"	21@about 22"	13@11"	19'-0"	19'-0"	7@11"	16@about 22"	12@11"	20'
No Lugs		No Lugs	18@about 22"	8@11"	No Lugs	9@11"	17@about 22"	4@11"	No Lugs	9@11"	22@about 22"	11@11"	No Lugs	No Lugs	6@11"	16@about 22"	11@11"	7@11"	20'	
Area A Negative Moment		19@about 22"	10@11"	10@11"	Area A Negative Moment	6@11"	18@about 22"	5@11"	Area A Negative Moment	10@11"	22@about 22"	8@11"	Area A Negative Moment	8@11"	17@about 22"	17@about 22"	No Lugs	No Lugs	No Lugs	
0.4 End span length (typ.)		13'-0"		13'-0"		13'-0"		13'-0"		13'-0"		13'-0"		13'-0"		13'-0"		13'-0"		
0.5 Interior span length (typ.)		13'-0"		13'-0"		13'-0"		13'-0"		13'-0"		13'-0"		13'-0"		13'-0"		13'-0"		
Splice Lengths		A 65'-0 3/4"	65'-0 3/4"	65'-0"	65'-0"	65'-0"	65'-0"	65'-0"	65'-0"	65'-0"	65'-0"	65'-0"	65'-0"	65'-0"	65'-0"	65'-0"	65'-0"	65'-0"	65'-0"	65'-0"
Diaphragm Spacing		A 16'-3 3/4"	3 spaces @ 16'-3"	16'-2 1/2"	3 spaces @ 16'-2 1/2"	16'-2 1/2"	3 spaces @ 16'-2 1/2"	16'-2 1/2"	3 spaces @ 16'-2 1/2"	16'-2 1/2"	3 spaces @ 16'-2 1/2"	16'-2 1/2"	3 spaces @ 16'-2 1/2"	16'-2 1/2"	3 spaces @ 16'-2 1/2"	16'-2 1/2"	3 spaces @ 16'-2 1/2"	16'-2 1/2"	3 spaces @ 16'-2 1/2"	16'-2 1/2"
Flange Plates		A 12'-8" Top 12'-8" Bottom	12'-8" Top 12'-8" Bottom	12'-8" Top 12'-8" Bottom	12'-8" Top 12'-8" Bottom	12'-8" Top 12'-8" Bottom	12'-8" Top 12'-8" Bottom	12'-8" Top 12'-8" Bottom	12'-8" Top 12'-8" Bottom	12'-8" Top 12'-8" Bottom	12'-8" Top 12'-8" Bottom	12'-8" Top 12'-8" Bottom	12'-8" Top 12'-8" Bottom	12'-8" Top 12'-8" Bottom	12'-8" Top 12'-8" Bottom	12'-8" Top 12'-8" Bottom	12'-8" Top 12'-8" Bottom	12'-8" Top 12'-8" Bottom	12'-8" Top 12'-8" Bottom	12'-8" Top 12'-8" Bottom
Note:		All dimensions shown on girder elevation are measured along the center line of girder.																		
GIRDER ELEVATION		No Scale																		
SUMMARY OF QUANTITIES BRIDGE 3C		Structural Steel (MHD 3306) 170,100 pounds Floor Drains (Type B-3) 2																		

DEAD LOAD DEFLECTIONS																					
GIRDER																					
		5 equal spaces										5 equal spaces									
A	Δ C	0.007	0.029	0.046	0.036	0.015	0	0.003	0.015	0.011	0.004	0	0.044	0.092	0.090	0.040	0	-0.004	0.010	0.010	-0.013
	Δ T	0.010	0.032	0.050	0.040	0.016	0	0.003	0.017	0.012	0.005	0	0.050	0.103	0.101	0.045	0	-0.004	0.011	0.020	-0.016
	Δ	0.011	0.021	0.034	0.027	0.009	0	0.003	0.015	0.012	0.002	0	0.032	0.070	0.069	0.030	0	-0.005	0.004	0.012	-0.016
B	Δ C	0.004	0.023	0.038	0.030	0.010	0	0.004	0.018	0.014	0.003	0	0.037	0.081	0.080	0.035	0	-0.007	0.004	0.012	-0.019
	Δ T	0.009	0.023	0.043	0.034	0.012	0	0.004	0.020	0.018	0.002	0	0.045	0.092	0.091	0.045	0	-0.002	0.008	0.017	-0.014
	Δ T	0.010	0.031	0.048	0.038	0.014	0	0.005	0.022	0.020	0.003	0	0.051	0.103	0.102	0.051	0	-0.002	0.009	0.018	-0.017

CAMBER DIAGRAM																				
Brg Exp II Elev. Girder A-643.369 Girder B-643.320 Girder C-643.671 Pier 3 A-10% B-10% C-10% E.F.S. 3 Pier 2 E.F.S. 2 E.F.S. 1 Pier 1 Brg Exp II																				
CAMBER DIMENSIONS																				
GIRDER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	-0'-4"	-0'-7 1/2"	-0'-9 3/4"	-0'-10 1/2"	-0'-11 1/2"	-0'-10 1/8"	-0'-7 3/4"	-0'-3 3/8"	-0'-0 3/8"	-0'-5 3/8"	-0'-11 3/8"	1'-6 3/8"	2'-0 3/8"	2'-5 3/8"	2'-9 3/8"	2'-10 3/8"	2'-10 3/8"	2'-9 3/8"	2'-8 3/8"	2'-8 3/8"
B	-0'-4 1/2"	-0'-7 1/8"	-0'-9 3/8"	-0'-10 1/8"	-0'-10 3/8"	-0'-9 3/8"	-0'-7 1/4"	-0'-3 3/8"	-0'-1 1/4"	-0'-6 3/8"	-0'-11 3/8"	1'-5 3/8"	2'-3 3/8"	2'-5 3/8"	2'-6 3/8"	2'-6 3/8"	2'-6 3/8"	2'-5 3/8"	2'-4 3/8"	2'-2 3/8"
C	-0'-6 1/2"	-0'-7 3/8"	-0'-9 1/4"	-0'-10 1/4"	-0'-10 1/4"	-0'-9 1/4"	-0'-7 1/4"	-0'-3 3/4"	-0'-1 1/2"	0'-6 1/2"	1'-0"	1'-5 1/2"	1'-9 1/2"	2'-0 1/2"	2'-2 1/2"	2'-2 1/2"	2'-2 1/2"	2'-0 1/2"	1'-10 1/2"	1'-8 1/2"

H.N.T.B. BR. NO. 2A, 2C-2K, 3A-3E
TRUNK HIGHWAY NO. 35
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS
INTERSTATE ROUTES IN DULUTH
BRIDGE NO. 69801
FRAMING PLAN
BRIDGE 3C
MICRO-FILMED
APPROVED: 7-30-68



BILL OF REINFORCEMENT							
BAR	NO.	SIZE	LENGTH	TYPE	DIMENSIONS		LOCATION
					A	B	
S401	1339	4	4'-9"	177	1'-6"	9"	Safety Curb
S402	2Ser. o f 14	4	28'-6" 29'-9"	Str.			Longitudinal
S403	1Ser. o f 14	4	20'-0" 30'-0"	Str.			"
S404	92	4	40'-0"	Str.			"
L 801	8	8	7'-3"	132	0'-11"	1'-0"	Lamp Anchor
S501	234	5	40'-0"	Str.			Longitudinal
S502	2Ser. o f 36	5	28'-6" 29'-9"	Str.			"
S503	1Ser. o f 36	5	20'-0" 30'-0"	Str.			"
S504	2	5	25'-0"	Str.			Transverse
L612	8	6	7'-5"	112	2'-5"	10"	Lamp Anchor
S601	13Ser. o f 3	6	15'-0" 17'-0"	Str.			Long. Over Pier
S602	82	6	27'-0"	Str.			"
S603	47	6	26'-0"	Str.			"
S604	802	6	25'-0"	Str.			Transverse
S605	2Ser. o f 14	6	25'-3" 28'-3"	Str.			"
S606	2Ser. o f 14	6	28'-4" 34'-10"	Str.			"
S620	8	6	4'-0"	Str.			Scupper

UNITS 1 AND 2 BRIDGE 3A QUANTITIES		
ITEM	UNIT	QUANTITY
Concrete Mix 3Y6	Cu. Yd.	190
Reinforcing Bars	Pounds	82,080
① 1" x 1/4" Conduit with Caps	Each	1 @ 8'-0"
Concrete Mix 3Y60	Cu. Yd.	2
② Bridge name plate	Unit	1

SECTION B-B
No Scale

① Included in Price bid for other items.
Quantities for slab protection angles
(M.H.D. 3306) and accessories are
included in Framing Plan quantities.

② Bridge No. 69801
Proj. No. FAI 535-7-25 Date: 1970

H.N.T.B. BR. NO. 2A, 2C-2K, 3A-3E
TRUNK HIGHWAY NO. 35
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS
INTERSTATE ROUTES IN DULUTH
BRIDGE NO. 69801

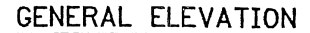
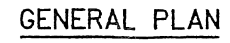
SLAB PLAN
UNITS 1 AND 2
BRIDGE 3A

APPROVED: 7-30-68

SHEET NO. 126 OF 1895 SHEETS 69801

DES.	
DCH.	
DR.	I.C.H.
CH.	TCY

I-10



(DIMENSIONS TAKEN ALONG C/L OF 535 SB TO 35 SB ROADWAY.)

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNED Duane M. Green Jr. 3/3/06
DATE
LICENSED PROFESSIONAL ENGINEER
NAME: DUANE M. GREEN JR. LIC NO. 13361



B.M. ELEV.		0451.1 1929 ADJ	
TRUNK HIGHWAY NO. 35 MINNESOTA DEPARTMENT OF TRANSPORTATION			
BRIDGE NO. 69801J 535 TH TO 35 S.B. AND 22ND AVE LOCATED IN DULUTH			
IDENTIFICATION NO.			
GENERAL PLAN AND ELEVATION			
SEC. 33		T 50 N R 14 W	
DULUTH TOWNSHIP		ST. LOUIS COUNTY	
APPROVED		<i>Kevin Westman</i>	
DATE <i>3/3/06</i>		STATE BRIDGE ENGINEER <i>for</i>	
DES.	DR.	CAG	69801J
CHK.	CHK.	DCH	

Printed
2/17/2010

Girder 7 Member Properties Used in Reanalysis

Tenth Point	Noncomp Dead			Superimposed Dead			Live Load		
	Ix (in4)	J (in4)	Iy (in4)	Ix (in4)	J (in4)	Iy (in4)	Ix (in4)	J (in4)	Iy (in4)
0	6953	5	234	6953	409	4304	6953	1219	12444
1	6953	5	234	13608	420	4643	18754	1251	13461
2	6953	5	234	13721	431	5000	18874	1284	14533
3	6953	5	234	13851	444	5441	19009	1323	15855
4	6953	5	234	13977	456	5908	19140	1361	17256
5	6953	5	234	14101	469	6402	19266	1399	18738
6	6953	5	234	14231	483	6962	19397	1440	20420
7	6953	5	234	14367	497	7596	19532	1484	22322
8	6953	5	234	14508	513	8313	19670	1530	24471
9	8289	10	288	8289	10	288	8289	10	288
10	8289	10	288	8289	10	288	8289	10	288
11	8289	10	288	17201	576	11532	23362	1712	34019
12	8289	10	288	17483	606	13415	23634	1802	39669
13	8289	10	288	17762	637	15563	23898	1895	46115
14	8289	10	288	18045	670	18081	24159	1994	53668
15	8289	10	288	18331	705	21024	24418	2098	62497
16	8289	10	288	18411	715	21933	24490	2128	65223
17	8289	10	288	18411	715	21933	24490	2128	65223
18	8289	10	288	8289	10	288	8289	10	288
19	8289	10	288	8289	10	288	8289	10	288
20	15886	47	505	15886	47	505	15886	47	505
21	12970	35	450	12970	35	450	12970	35	450
22	12970	35	450	22134	510	7373	30666	1477	21218
23	12970	35	450	22442	533	8399	31048	1545	24298
24	12970	35	450	22777	558	9664	31455	1622	28092
25	12970	35	450	23126	586	11161	31868	1704	32583
26	12970	35	450	23498	616	12985	32297	1794	38057
27	12970	35	450	23891	649	15200	32739	1892	44701
28	12970	35	450	24300	684	17878	33187	1999	52735
29	12970	35	450	24715	722	21024	33629	2111	62172
30	12970	35	450	12970	35	450	12970	35	450
31	6861	4	216	6861	4	216	6861	4	216
32	7350	4	216	16028	623	19200	21142	1862	57169
33	7859	4	216	17013	623	19200	22449	1863	57169
34	8388	4	216	18032	623	19200	23804	1863	57169
35	8937	4	216	19085	623	19200	25206	1863	57169
36	9507	4	216	20174	623	19200	26657	1863	57169
37	10098	4	216	21298	623	19200	28157	1863	57169
38	10711	4	216	22457	623	19200	29707	1863	57169
39	10817	4	216	10817	4	216	10817	4	216
40	16734	16	360	16734	16	360	16734	16	360
41	9514	3	180	9514	3	180	9514	3	180
42	9514	3	180	19474	621	19164	25309	1861	57133
43	9514	3	180	19474	621	19164	25309	1861	57133
44	9514	3	180	19474	621	19164	25309	1861	57133
45	9514	3	180	19474	621	19164	25309	1861	57133
46	9514	3	180	19474	621	19164	25309	1861	57133
47	9514	3	180	19474	621	19164	25309	1861	57133
48	13797	9	288	13797	9	288	13797	9	288
49	13797	9	288	13797	9	288	13797	9	288
50	22809	44	504	22809	44	504	22809	44	504
51	10926	4	216	10926	4	216	10926	4	216
52	12462	9	270	26995	628	19254	36658	1868	57223
53	12462	9	270	26995	628	19254	36658	1868	57223
54	12462	9	270	26995	628	19254	36658	1868	57223
55	12462	9	270	26995	628	19254	36658	1868	57223
56	12462	9	270	26995	628	19254	36658	1868	57223
57	12462	9	270	26995	628	19254	36658	1868	57223
58	12462	9	270	26995	628	19254	36658	1868	57223
59	10926	4	216	10926	4	216	10926	4	216
60	24370	53	540	24370	53	540	24370	53	540
61	16734	16	360	16734	16	360	16734	16	360
62	16734	16	360	16734	16	360	16734	16	360
63	10817	4	216	22656	623	19200	29974	1863	57169

Typ Area = 40 in²
approximation

Max Thickness = 1"
d_z = 6"
I_{yy} Risa = I_y max
I_{zz} Risa = I_x max
dy-top, see max
dy-bot, see max

P3-3E

P2-3E

P1-3E

Tapered
Section

P3-3C

P2-3C

P1-3C

	Ix	J	Iy	Ix	J	Iy	Ix	J	Iy	
64	10817	4	216	22656	623	19200	29974	1863	57169	
65	10817	4	216	22656	623	19200	29974	1863	57169	
66	10817	4	216	22656	623	19200	29974	1863	57169	
67	10817	4	216	22656	623	19200	29974	1863	57169	
68	10817	4	216	22656	623	19200	29974	1863	57169	
69	15454	17	342	15454	17	342	15454	17	342	
70	15454	17	342	15454	17	342	15454	17	342	P7-3A
71	15454	17	342	30548	634	19326	41499	1873	57295	
72	15454	17	342	30548	634	19326	41499	1873	57295	
73	15454	17	342	30548	634	19326	41499	1873	57295	
74	15454	17	342	30548	634	19326	41499	1873	57295	
75	15454	17	342	30548	634	19326	41499	1873	57295	
76	15454	17	342	30548	634	19326	41499	1873	57295	
77	15454	17	342	30548	634	19326	41499	1873	57295	
78	19738	28	432	19738	28	432	19738	28	432	
79	29157	92	648	29157	92	648	29157	92	648	
80	29543	92	648	29543	92	648	29543	92	648	P6-3A ← should be same as neighbors.
81	29157	92	648	29157	92	648	29157	92	648	
82	22809	44	504	22809	44	504	22809	44	504	
83	17513	26	396	33645	642	19380	46018	1881	57349	
84	17513	26	396	33645	642	19380	46018	1881	57349	
85	17513	26	396	33645	642	19380	46018	1881	57349	
86	17513	26	396	33645	642	19380	46018	1881	57349	
87	17513	26	396	33645	642	19380	46018	1881	57349	
88	17513	26	396	33645	642	19380	46018	1881	57349	
89	17513	26	396	33645	642	19380	46018	1881	57349	
90	19603	31	397	19603	31	397	19603	31	397	P5-3A
91	12948	30	397	12948	30	397	12948	30	397	← at hinge, Reduced ignore
92	11986	21	374	21208	633	19359	28777	1872	57328	
93	11986	21	374	21208	633	19359	28777	1872	57328	
94	11986	21	374	21208	633	19359	28777	1872	57328	
95	11986	21	374	21208	633	19359	28777	1872	57328	
96	11986	21	374	21208	633	19359	28777	1872	57328	
97	11986	21	374	21208	633	19359	28777	1872	57328	
98	11986	21	374	21208	633	19359	28777	1872	57328	
99	11986	21	374	11986	21	374	11986	21	374	
100	19714	21	374	19714	21	374	19714	21	374	P4-3A
101	19714	21	374	19714	21	374	19714	21	374	
102	8894	9	269	8894	9	269	8894	9	269	
103	8894	9	269	17064	625	19253	22816	1865	57222	
104	8894	9	269	17064	625	19253	22816	1865	57222	
105	8894	9	269	17064	625	19253	22816	1865	57222	
106	8894	9	269	17064	625	19253	22816	1865	57222	
107	8894	9	269	17064	625	19253	22816	1865	57222	
108	8894	9	269	17064	625	19253	22816	1865	57222	
109	8120	8	270	8120	8	270	8120	8	270	
110	13782	35	468	13782	35	468	13782	35	468	P3-3A
111	13782	35	468	13782	35	468	13782	35	468	
112	8120	8	270	17218	626	19254	22984	1865	57223	
113	8120	8	270	17218	626	19254	22984	1865	57223	
114	8120	8	270	17218	626	19254	22984	1865	57223	
115	8120	8	270	17218	626	19254	22984	1865	57223	
116	8120	8	270	17218	626	19254	22984	1865	57223	
117	8120	8	270	17218	626	19254	22984	1865	57223	
118	8120	8	270	17218	626	19254	22984	1865	57223	
119	8120	8	270	8120	8	270	8120	8	270	
120	13782	35	468	13782	35	468	13782	35	468	
121	13782	35	468	13782	35	468	13782	35	468	P2-3A
122	7151	5	234	7151	5	234	7151	5	234	
123	7151	5	234	15959	624	19218	21244	1864	57187	
124	7151	5	234	15959	624	19218	21244	1864	57187	
125	7151	5	234	15959	624	19218	21244	1864	57187	
126	7151	5	234	15959	624	19218	21244	1864	57187	
127	7151	5	234	15959	624	19218	21244	1864	57187	
128	7151	5	234	15959	624	19218	21244	1864	57187	
129	7151	5	234	7151	5	234	7151	5	234	
130	7151	5	234	7151	5	234	7151	5	234	P1-3A
131	13884	43	486	13884	43	486	13884	43	486	← at hinge, ignore
132	13775	42	486	25166	652	19470	34141	1891	57439	
133	13775	42	486	25166	652	19470	34141	1891	57439	
134	13775	42	486	25166	652	19470	34141	1891	57439	
135	13775	42	486	25166	652	19470	34141	1891	57439	
136	13775	42	486	25166	652	19470	34141	1891	57439	
137	13775	42	486	25166	652	19470	34141	1891	57439	
138	13775	42	486	25166	652	19470	34141	1891	57439	
139	13775	42	486	25166	652	19470	34141	1891	57439	
140	13775	42	486	13775	42	486	13775	42	486	Abutment

Girder 7 Elastic Section Properties for Stiffness Analysis

$$f'_c \text{ conc} = 4000 \text{ psi}$$

$$\therefore n = 8$$

Tenth Point	----- Noncomp -----			----- Comp ----- (n = 8)			----- Comp ----- (3n = 24)		
	I	na from Bott	na from Top Flg	I	na from Bott	na from Top Flg	I	na from Bott	na from Top Flg
0	6953.	15.51	20.11	6953.	15.51	20.11	6953.	15.51	20.11
1	6953.	15.51	20.11	18754.	30.43	5.20	13609.	24.00	11.62
2	6953.	15.51	20.11	18874.	30.57	5.05	13722.	24.15	11.48
3	6953.	15.51	20.11	19009.	30.74	4.89	13851.	24.31	11.31
4	6953.	15.51	20.11	19140.	30.90	4.73	13978.	24.47	11.15
5	6953.	15.51	20.11	19267.	31.05	4.58	14102.	24.63	11.00
6	6953.	15.51	20.11	19398.	31.21	4.42	14232.	24.79	10.83
7	6953.	15.51	20.11	19532.	31.37	4.26	14367.	24.96	10.66
8	6953.	15.51	20.11	19670.	31.54	4.09	14508.	25.14	10.48
9	8290.	15.31	20.69	8290.	15.31	20.69	8290.	15.31	20.69
10	8290.	15.31	20.69	8290.	15.31	20.69	8290.	15.31	20.69
11	8290.	15.31	20.69	23362.	31.61	4.39	17202.	25.05	10.95
12	8290.	15.31	20.69	23635.	31.89	4.11	17484.	25.35	10.65
13	8290.	15.31	20.69	23898.	32.16	3.84	17762.	25.66	10.34
14	8290.	15.31	20.69	24160.	32.42	3.58	18045.	25.96	10.04
15	8290.	15.31	20.69	24419.	32.69	3.31	18331.	26.27	9.73
16	8290.	15.31	20.69	24491.	32.76	3.24	18412.	26.36	9.64
17	8290.	15.31	20.69	24491.	32.76	3.24	18412.	26.36	9.64
18	8290.	15.31	20.69	8290.	15.31	20.69	8290.	15.31	20.69
19	8290.	15.31	20.69	8290.	15.31	20.69	8290.	15.31	20.69
20	15887.	18.75	18.75	15887.	18.75	18.75	15887.	18.75	18.75
21	12971.	16.22	20.91	12971.	16.22	20.91	12971.	16.22	20.91
22	12971.	16.22	20.91	30667.	29.61	7.51	22134.	23.20	13.93
23	12971.	16.22	20.91	31049.	29.90	7.23	22442.	23.43	13.69
24	12971.	16.22	20.91	31456.	30.20	6.93	22778.	23.69	13.44
25	12971.	16.22	20.91	31869.	30.50	6.62	23127.	23.95	13.18
26	12971.	16.22	20.91	32298.	30.82	6.31	23499.	24.23	12.89
27	12971.	16.22	20.91	32739.	31.14	5.98	23891.	24.53	12.60
28	12971.	16.22	20.91	33188.	31.47	5.66	24301.	24.84	12.29
29	12971.	16.22	20.91	33630.	31.79	5.33	24716.	25.15	11.97
30	12971.	16.22	20.91	12971.	16.22	20.91	12971.	16.22	20.91
31	6862.	16.34	19.33	6862.	16.34	19.33	6862.	16.34	19.33
32	7351.	16.86	19.90	21143.	33.80	2.96	16029.	27.66	9.10
33	7859.	17.38	20.48	22450.	34.66	3.19	17014.	28.36	9.49
34	8388.	17.90	21.05	23804.	35.52	3.43	18032.	29.06	9.89
35	8938.	18.42	21.62	25207.	36.37	3.67	19086.	29.75	10.29
36	9508.	18.94	22.19	26658.	37.22	3.91	20174.	30.44	10.69
37	10099.	19.47	22.75	28158.	38.07	4.15	21298.	31.13	11.10
38	10712.	19.99	23.32	29708.	38.92	4.39	22457.	31.81	11.50
39	10817.	20.08	23.42	10817.	20.08	23.42	10817.	20.08	23.42
40	16734.	22.25	22.25	16734.	22.25	22.25	16734.	22.25	22.25
41	9515.	21.62	21.62	9515.	21.62	21.62	9515.	21.62	21.62
42	9515.	21.62	21.62	25309.	39.81	3.44	19474.	33.23	10.02
43	9515.	21.62	21.62	25309.	39.81	3.44	19474.	33.23	10.02
44	9515.	21.62	21.62	25309.	39.81	3.44	19474.	33.23	10.02
45	9515.	21.62	21.62	25309.	39.81	3.44	19474.	33.23	10.02
46	9515.	21.62	21.62	25309.	39.81	3.44	19474.	33.23	10.02
47	9515.	21.62	21.62	25309.	39.81	3.44	19474.	33.23	10.02
48	13797.	22.00	22.00	13797.	22.00	22.00	13797.	22.00	22.00
49	13797.	22.00	22.00	13797.	22.00	22.00	13797.	22.00	22.00
50	22810.	22.75	22.75	22810.	22.75	22.75	22810.	22.75	22.75
51	10926.	21.75	21.75	10926.	21.75	21.75	10926.	21.75	21.75
52	12462.	18.22	25.65	36659.	38.03	5.84	26995.	30.21	13.67
53	12462.	18.22	25.65	36659.	38.03	5.84	26995.	30.21	13.67
54	12462.	18.22	25.65	36659.	38.03	5.84	26995.	30.21	13.67
55	12462.	18.22	25.65	36659.	38.03	5.84	26995.	30.21	13.67
56	12462.	18.22	25.65	36659.	38.03	5.84	26995.	30.21	13.67
57	12462.	18.22	25.65	36659.	38.03	5.84	26995.	30.21	13.67
58	12462.	18.22	25.65	36659.	38.03	5.84	26995.	30.21	13.67
59	10926.	21.75	21.75	10926.	21.75	21.75	10926.	21.75	21.75
60	24371.	22.88	22.88	24371.	22.88	22.88	24371.	22.88	22.88
61	16734.	22.25	22.25	16734.	22.25	22.25	16734.	22.25	22.25
62	16734.	22.25	22.25	16734.	22.25	22.25	16734.	22.25	22.25

P3-3E

P2-3E

P1-3E

10.3

P3-3C

P2-3C

P1-3C

Noncomp.				Comp n=8				Comp, 3n=24			
I	na from	Bot	na from Top	I	na from	Bot	na from Top	I	na from	Bot	na from Top
63	10817.	20.08	23.42	29974.	39.07	4.43		22657.	31.93	11.57	
64	10817.	20.08	23.42	29974.	39.07	4.43		22657.	31.93	11.57	
65	10817.	20.08	23.42	29974.	39.07	4.43		22657.	31.93	11.57	
66	10817.	20.08	23.42	29974.	39.07	4.43		22657.	31.93	11.57	
67	10817.	20.08	23.42	29974.	39.07	4.43		22657.	31.93	11.57	
68	10817.	20.08	23.42	29974.	39.07	4.43		22657.	31.93	11.57	
69	15455.	18.95	25.42	15455.	18.95	25.42		15455.	18.95	25.42	
70	15455.	18.95	25.42	15455.	18.95	25.42		15455.	18.95	25.42	P7-3A
71	15455.	18.95	25.42	41500.	37.71	6.67		30549.	29.89	14.48	
72	15455.	18.95	25.42	41500.	37.71	6.67		30549.	29.89	14.48	
73	15455.	18.95	25.42	41500.	37.71	6.67		30549.	29.89	14.48	
74	15455.	18.95	25.42	41500.	37.71	6.67		30549.	29.89	14.48	
75	15455.	18.95	25.42	41500.	37.71	6.67		30549.	29.89	14.48	
76	15455.	18.95	25.42	41500.	37.71	6.67		30549.	29.89	14.48	
77	15455.	18.95	25.42	41500.	37.71	6.67		30549.	29.89	14.48	
78	19738.	22.50	22.50	19738.	22.50	22.50		19738.	22.50	22.50	
79	29158.	23.25	23.25	29158.	23.25	23.25		29158.	23.25	23.25	P6-3A
80	29544.	23.25	23.25	29544.	23.25	23.25		29544.	23.25	23.25	
81	29158.	23.25	23.25	29158.	23.25	23.25		29158.	23.25	23.25	
82	22810.	22.75	22.75	22810.	22.75	22.75		22810.	22.75	22.75	
83	17514.	18.83	25.92	46019.	37.27	7.48		33645.	29.33	15.42	
84	17514.	18.83	25.92	46019.	37.27	7.48		33645.	29.33	15.42	
85	17514.	18.83	25.92	46019.	37.27	7.48		33645.	29.33	15.42	
86	17514.	18.83	25.92	46019.	37.27	7.48		33645.	29.33	15.42	
87	17514.	18.83	25.92	46019.	37.27	7.48		33645.	29.33	15.42	
88	17514.	18.83	25.92	46019.	37.27	7.48		33645.	29.33	15.42	
89	17514.	18.83	25.92	46019.	37.27	7.48		33645.	29.33	15.42	
90	19604.	19.63	25.12	19604.	19.63	25.12		19604.	19.63	25.12	P5-3A
91	12949.	16.25	21.21	12949.	16.25	21.21		12949.	16.25	21.21	
92	11986.	18.24	18.24	28777.	31.39	5.09		21208.	25.53	10.95	
93	11986.	18.24	18.24	28777.	31.39	5.09		21208.	25.53	10.95	
94	11986.	18.24	18.24	28777.	31.39	5.09		21208.	25.53	10.95	
95	11986.	18.24	18.24	28777.	31.39	5.09		21208.	25.53	10.95	
96	11986.	18.24	18.24	28777.	31.39	5.09		21208.	25.53	10.95	
97	11986.	18.24	18.24	28777.	31.39	5.09		21208.	25.53	10.95	
98	11986.	18.24	18.24	28777.	31.39	5.09		21208.	25.53	10.95	
99	11986.	18.24	18.24	11986.	18.24	18.24		11986.	18.24	18.24	P4-3A
100	19714.	19.24	19.24	19714.	19.24	19.24		19714.	19.24	19.24	
101	19714.	19.24	19.24	19714.	19.24	19.24		19714.	19.24	19.24	
102	8894.	17.92	17.92	8894.	17.92	17.92		8894.	17.92	17.92	
103	8894.	17.92	17.92	22816.	32.19	3.65		17065.	26.40	9.44	
104	8894.	17.92	17.92	22816.	32.19	3.65		17065.	26.40	9.44	
105	8894.	17.92	17.92	22816.	32.19	3.65		17065.	26.40	9.44	
106	8894.	17.92	17.92	22816.	32.19	3.65		17065.	26.40	9.44	
107	8894.	17.92	17.92	22816.	32.19	3.65		17065.	26.40	9.44	
108	8894.	17.92	17.92	22816.	32.19	3.65		17065.	26.40	9.44	
109	8121.	15.95	19.89	8121.	15.95	19.89		8121.	15.95	19.89	P3-3A
110	13783.	18.60	18.60	13783.	18.60	18.60		13783.	18.60	18.60	
111	13783.	18.60	18.60	13783.	18.60	18.60		13783.	18.60	18.60	
112	8121.	15.95	19.89	22985.	32.33	3.50		17218.	26.10	9.74	
113	8121.	15.95	19.89	22985.	32.33	3.50		17218.	26.10	9.74	
114	8121.	15.95	19.89	22985.	32.33	3.50		17218.	26.10	9.74	
115	8121.	15.95	19.89	22985.	32.33	3.50		17218.	26.10	9.74	
116	8121.	15.95	19.89	22985.	32.33	3.50		17218.	26.10	9.74	
117	8121.	15.95	19.89	22985.	32.33	3.50		17218.	26.10	9.74	
118	8121.	15.95	19.89	22985.	32.33	3.50		17218.	26.10	9.74	
119	8121.	15.95	19.89	8121.	15.95	19.89		8121.	15.95	19.89	P2-3A
120	13783.	18.60	18.60	13783.	18.60	18.60		13783.	18.60	18.60	
121	13783.	18.60	18.60	13783.	18.60	18.60		13783.	18.60	18.60	
122	7152.	15.65	19.94	7152.	15.65	19.94		7152.	15.65	19.94	
123	7152.	15.65	19.94	21244.	32.48	3.10		15960.	26.31	9.27	
124	7152.	15.65	19.94	21244.	32.48	3.10		15960.	26.31	9.27	
125	7152.	15.65	19.94	21244.	32.48	3.10		15960.	26.31	9.27	
126	7152.	15.65	19.94	21244.	32.48	3.10		15960.	26.31	9.27	
127	7152.	15.65	19.94	21244.	32.48	3.10		15960.	26.31	9.27	
128	7152.	15.65	19.94	21244.	32.48	3.10		15960.	26.31	9.27	
129	7152.	15.65	19.94	7152.	15.65	19.94		7152.	15.65	19.94	P1-3A
130	7152.	15.65	19.94	7152.	15.65	19.94		7152.	15.65	19.94	
131	13775.	16.35	20.98	13775.	16.35	20.98		13775.	16.35	20.98	
132	13775.	16.35	20.98	34141.	31.52	5.82		25166.	24.90	12.43	
133	13775.	16.35	20.98	34141.	31.52	5.82		25166.	24.90	12.43	
134	13775.	16.35	20.98	34141.	31.52	5.82		25166.	24.90	12.43	
135	13775.	16.35	20.98	34141.	31.52	5.82		25166.	24.90	12.43	
136	13775.	16.35	20.98	34141.	31.52	5.82		25166.	24.90	12.43	
137	13775.	16.35	20.98	34141.	31.52	5.82		25166.	24.90	12.43	
138	13775.	16.35	20.98	34141.	31.52	5.82		25166.	24.90	12.43	
139	13775.	16.35	20.98	34141.	31.52	5.82		25166.	24.90	12.43	
140	13775.	16.35	20.98	13775.	16.35	20.98		13775.	16.35	20.98	Abutment



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PROJECT MnDOT SS-69801 J - P4-3A Boundary Condition -1

PROJECT # 090147 DATE 3/9/10 BY jelf SHEET NO. 10110 OF 10110

Boundary condition for P4-3A node.

Model it with springs.

Units are kips/in. and kip·ft/radian

Need spring constants for:
X, and Z rotation

X translation: This will be a mixture of the footing translation (already determined to be 143.2 kip/in. in the Braking Force (page 6) calculations) and the lateral translation due to column bending.

The translation w/ a load of 75.1 kip and no spring at the footing is .639" per Rise 30. The column spring is $75.1 / .639 = 117.5$ kip/in.

$$X_{\text{spring translation}} = \left(\frac{1}{143.2} + \frac{1}{117.5} \right) = 64.5 \text{ kip/in.}$$

Z Rotation is a mixture of Rotation from the column bending and pier cap twisting.

The column bending Rotation for a 100 kip·ft moment located at the top of the column is 1.248×10^{-4} Radians. The column spring is $100 / 1.248 \times 10^{-4} = 801282$ kip·ft/Radian.

The pier cap bending Rotation w/ $J = 17440 \text{ in}^4$ and a 100 kip·ft torque located at the end of the pier cap is 7.893×10^{-4} Radians. The pier cap spring is $100 / 7.893 \times 10^{-4} = 126695$ kip·ft/Radian.



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PROJECT MnDOT SS-69801 J- P4-3A Boundary Condition -2

PROJECT # 090147 DATE 3/9/10 BY jdf _{LSM5/10/10} SHEET NO. _____ OF _____

$$Z \text{ rotation} = \left(\frac{1}{801282} + \frac{1}{126695} \right) = 109398 \text{ kip-ft/Radian}$$



LHB

jdf

090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

May 10, 2010 at 3:06 PM

090147_3A_P4_GirderABeamA_PierTranslatio...

61-I

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

May 10, 2010
 3:06 PM
 Checked By: *CSM*

5/10/10

Global

Display Sections for Member Calcs	3
Max Internal Sections for Member Calcs	99
Include Shear Deformation	Yes
Include Warping	No
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Vertical Axis	Y

Hot Rolled Steel Code	AISC : ASD 13th (Direct Analysis Method)
Cold Formed Steel Code	AISI 01: ASD
Wood Code	NDS 2005: ASD
Wood Temperature	< 100F
Concrete Code	ACI 2005
Masonry Code	MSJC 05/IBC 06 ASD

Number of Shear Regions	4
Region Spacing Increment (in)	4
Biaxial Column Method	Exact Integration
Parame Beta Factor (PCA)	.65
Concrete Stress Block	Rectangular
Use Cracked Sections	Yes
Bad Framing Warnings	No
Unused Force Warnings	Yes

Footing Overturning Safety Factor	1.5
Check Concrete Bearing	Yes
Self Wt, Overburden in DL for Design	Yes
Footing Concrete Weight	.145 k/ft^3
Footing Concrete f _c	3 ksi
Footing Concrete E _c	4000 ksi
Footing Steel f _y	60 ksi
Minimum Steel	0.0018
Maximum Steel	0.0075
Footing Top Bar	#3
Footing Top Bar Cover	3.5 in
Footing Bottom Bar	#4
Footing Bottom Bar Cover	3.5 in
Pedestal Bar	#3
Pedestal Bar Cover	1.5 in
Pedestal Ties	#3

*Calculation
for translation
and rotation @
Pier 4.
(spring constant =
@ supports)*

General Material Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (1E5 F)	Density[k/ft^3]
1	gen Conc4NW	3644	1584	.15	.6	.145
2	gen Alum	10600	4077	.3	1.29	.173
3	gen Steel	29000	11154	.3	.65	.49
4	RIGID	1e+6		.3	0	0

Member Primary Data ✓

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1-1	H1	N16			I25303	Beam	None	gen_Steel	Typical
2	M1-2	N16	N17			I10817	Beam	None	gen_Steel	Typical
3	M1-3	N17	P3-3C			I16734	Beam	None	gen_Steel	Typical
4	M2-1	P3-3C	N22			I16734	Beam	None	gen_Steel	Typical

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

May 10, 2010
 3:06 PM
 Checked By: *CJW*

5/10/10

Member Primary Data (Continued)

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
5	M2-2	N22	N21			I09514	Beam	None	gen_Steel	Typical
6	M2-3	N21	N20			I25309	Beam	None	gen_Steel	Typical
7	M2-4	N20	N19			I09514	Beam	None	gen_Steel	Typical
8	M2-5	N19	N18			I13797	Beam	None	gen_Steel	Typical
9	M2-6	N18	P2-3C			I22809	Beam	None	gen_Steel	Typical
10	M3-1	P2-3C	N26			I22809	Beam	None	gen_Steel	Typical
11	M3-2	N26	N25			I10926	Beam	None	gen_Steel	Typical
12	M3-3	N25	N24			I36658	Beam	None	gen_Steel	Typical
13	M3-4	N24	N23			I10926	Beam	None	gen_Steel	Typical
14	M3-5	N23	P1-3C			I24370	Beam	None	gen_Steel	Typical
15	M4-1	P1-3C	N28			I24370	Beam	None	gen_Steel	Typical
16	M4-2	N28	N27			I16734	Beam	None	gen_Steel	Typical
17	M4-3	N27	H2			I29974	Beam	None	gen_Steel	Typical
18	M5-1	H2	P7-3A			I15454	Beam	None	gen_Steel	Typical
19	M6-1	P7-3A	N31			I15454	Beam	None	gen_Steel	Typical
20	M6-2	N31	N30			I41499	Beam	None	gen_Steel	Typical
21	M6-3	N30	N29			I19738	Beam	None	gen_Steel	Typical
22	M6-4	N29	P6-3A			I29157	Beam	None	gen_Steel	Typical
23	M7-1	P6-3A	N34			I29157	Beam	None	gen_Steel	Typical
24	M7-2	N34	N33			I22809	Beam	None	gen_Steel	Typical
25	M7-3	N33	N32			I46018	Beam	None	gen_Steel	Typical
26	M7-4	N32	P5-3A			I19603	Beam	None	gen_Steel	Typical
27	M8-1	P5-3A	H3			I19603	Beam	None	gen_Steel	Typical
28	M9-1	H3	N36			I28777	Beam	None	gen_Steel	Typical
29	M9-2	N36	N35			I11986	Beam	None	gen_Steel	Typical
30	M9-3	N35	P4-3A			I19714	Beam	None	gen_Steel	Typical
31	M10-1	P4-3A	N41			I19714	Beam	None	gen_Steel	Typical
32	M10-2	N41	N40			I11986	Beam	None	gen_Steel	Typical
33	M10-3	N40	N39			I08894	Beam	None	gen_Steel	Typical
34	M10-4	N39	N38			I22816	Beam	None	gen_Steel	Typical
35	M10-5	N38	N37			I08120	Beam	None	gen_Steel	Typical
36	M10-6	N37	P3-3A			I13782	Beam	None	gen_Steel	Typical
37	M11-1	P3-3A	N45			I13782	Beam	None	gen_Steel	Typical
38	M11-2	N45	N44			I08120	Beam	None	gen_Steel	Typical
39	M11-3	N44	N43			I22984	Beam	None	gen_Steel	Typical
40	M11-4	N43	N42			I08120	Beam	None	gen_Steel	Typical
41	M11-5	N42	P2-3A			I13782	Beam	None	gen_Steel	Typical
42	M12-1	P2-3A	N48			I13782	Beam	None	gen_Steel	Typical
43	M12-2	N48	N47			I07151	Beam	None	gen_Steel	Typical
44	M12-3	N47	N46			I21244	Beam	None	gen_Steel	Typical
45	M12-4	N46	P1-3A			I07151	Beam	None	gen_Steel	Typical
46	M13-1	P1-3A	H4			I07151	Beam	None	gen_Steel	Typical
47	M14-1	H4	H5			I34141	Beam	None	gen_Steel	Typical
48	M4-3A-COL	P4-3A-FTG	P4-3A			CRND60	Column	None	Conc4000...	Typical
49	M3-3A-COL	P3-3A-FTG	P3-3A			CRND54	Column	None	Conc4000...	Typical
50	M6-3A-COL	P6-3A-FTG	P6-3A			P6-3A-Pier	Column	None	gen_Conc...	Typical
51	M5-3A-COL	P5-3A-FTG	P5-3A			P5-3A-Pier	Column	None	gen_Conc...	Typical

Member Advanced Data

	Label	I Release	J Release	I Offset[in]	J Offset[in]	T/C Only	Physical	TOM	Inactive
1	M1-1						Yes		
2	M1-2						Yes		
3	M1-3						Yes		
4	M2-1						Yes		
5	M2-2						Yes		
6	M2-3						Yes		

5/10/10

Member Advanced Data (Continued) ✓

	Label	I Release	J Release	I Offset[in]	J Offset[in]	T/C Only	Physical	TOM	Inactive
7	M2-4						Yes		
8	M2-5						Yes		
9	M2-6						Yes		
10	M3-1						Yes		
11	M3-2						Yes		
12	M3-3						Yes		
13	M3-4						Yes		
14	M3-5						Yes		
15	M4-1						Yes		
16	M4-2						Yes		
17	M4-3						Yes		
18	M5-1	XOOOXX					Yes		
19	M6-1						Yes		
20	M6-2						Yes		
21	M6-3						Yes		
22	M6-4						Yes		
23	M7-1						Yes		
24	M7-2						Yes		
25	M7-3						Yes		
26	M7-4						Yes		
27	M8-1		XOOOXX				Yes		
28	M9-1						Yes		
29	M9-2						Yes		
30	M9-3						Yes		
31	M10-1						Yes		
32	M10-2						Yes		
33	M10-3						Yes		
34	M10-4						Yes		
35	M10-5						Yes		
36	M10-6						Yes		
37	M11-1						Yes		
38	M11-2						Yes		
39	M11-3						Yes		
40	M11-4						Yes		
41	M11-5						Yes		
42	M12-1						Yes		
43	M12-2						Yes		
44	M12-3						Yes		
45	M12-4						Yes		
46	M13-1		XOOOXX				Yes		
47	M14-1						Yes		
48	M4-3A-COL						Yes		
49	M3-3A-COL		BenPIN				Yes		Inactive
50	M6-3A-COL		BenPIN				Yes		Inactive
51	M5-3A-COL		BenPIN				Yes		Inactive

Joint Coordinates and Temperatures ✓

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
1	H1	0	0	0	0	
2	P3-3C	65.02	0	0	0	
3	P2-3C	146.04	0	0	0	
4	P1-3C	241.87	0	0	0	
5	H2	308.47	0	0	0	
6	P7-3A	316.47	0	0	0	
7	P6-3A	399.1	0	0	0	
8	P6-3A-FTG	399.1	-34.2	0	0	

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Joint Coordinates and Temperatures (Continued)

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
9	P5-3A	482.07	0	0	0	
10	P5-3A-FTG	482.07	-30.42	0	0	
11	H3	490.07	0	0	0	
12	P4-3A	557.06	0	0	0	
13	P4-3A-FTG	557.06	-33.75	0	0	
14	P3-3A	622.94	0	0	0	
15	P3-3A-FTG	622.94	-31.04	0	0	
16	P2-3A	689.22	0	0	0	
17	P1-3A	742.42	0	0	0	
18	H5	802.8	0	0	0	
19	H4	747.56	0	0	0	
20	N16	52.02	0	0	0	
21	N17	58.02	0	0	0	
22	N18	138.04	0	0	0	
23	N19	128.04	0	0	0	
24	N20	123.04	0	0	0	
25	N21	81.02	0	0	0	
26	N22	72.02	0	0	0	
27	N23	232.87	0	0	0	
28	N24	222.87	0	0	0	
29	N25	165.04	0	0	0	
30	N26	155.04	0	0	0	
31	N27	261.87	0	0	0	
32	N28	248.87	0	0	0	
33	N29	389.1	0	0	0	
34	N30	377.1	0	0	0	
35	N31	324.47	0	0	0	
36	N32	474.07	0	0	0	
37	N33	419.1	0	0	0	
38	N34	409.1	0	0	0	
39	N35	551.06	0	0	0	
40	N36	544.06	0	0	0	
41	N37	616.94	0	0	0	
42	N38	609.94	0	0	0	
43	N39	573.06	0	0	0	
44	N40	570.06	0	0	0	
45	N41	565.06	0	0	0	
46	N42	683.22	0	0	0	
47	N43	678.22	0	0	0	
48	N44	635.94	0	0	0	
49	N45	630.94	0	0	0	
50	N46	734.42	0	0	0	
51	N47	703.22	0	0	0	
52	N48	697.22	0	0	0	

Joint Boundary Conditions

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot [k-ft/rad]	Y Rot [k-ft/rad]	Z Rot [k-ft/rad]	Footing
1	H1	Reaction	Reaction	Reaction	Reaction			
2	P3-3C		Reaction	Reaction	Reaction			
3	P2-3C		Reaction	Reaction	Reaction			
4	P1-3C		Reaction	Reaction	Reaction			
5	P7-3A		Reaction	Reaction	Reaction			
6	P4-3A-FTG	Reaction	Reaction	Reaction	Reaction	Reaction	Reaction	
7	P2-3A		Reaction	Reaction	Reaction			
8	P1-3A		Reaction	Reaction	Reaction			
9	H5	Reaction	Reaction	Reaction	Reaction			

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

May 10, 2010
 3:06 PM
 Checked By: *CJM*

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Joint Boundary Conditions (Continued) ✓

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot.[k-ft/rad]	Y Rot.[k-ft/rad]	Z Rot.[k-ft/rad]	Footing
10	P6-3A	Reaction	Reaction	Reaction				
11	P5-3A		Reaction	Reaction				
12	P3-3A		Reaction	Reaction				

Joint Loads and Enforced Displacements (BLC 1 : Unit Horizontal Load) ✓

	Joint Label	L.D.M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft)
1	P4-3A	L	X	1

Basic Load Cases ✓

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distributed	Area (M...	Surface (...)
1	Unit Horizontal Load	None				1				

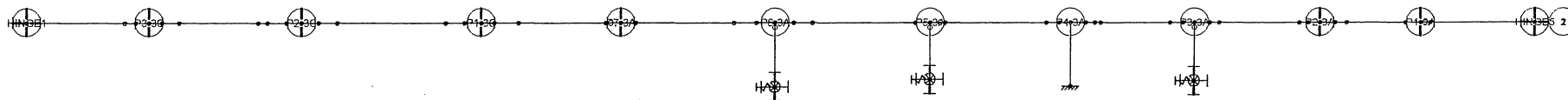
Load Combinations ✓

	Description	Sol...PD...SR...	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor
1	X_Translation	Yes	1	75.1							

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Joint Deflections (By Combination) ✓

	LC	Joint Label	X [in]	Y [in]	Z [in]	X Rotation [rad]	Y Rotation [rad]	Z Rotation [rad]
1	1	H1	0	0	0	0	0	1.795e-8
2	1	P3-3C	0	0	0	0	0	-4.657e-8
3	1	P2-3C	0	0	0	0	0	2.101e-7
4	1	P1-3C	0	0	0	0	0	-9.868e-7
5	1	H2	0	-.001	0	0	0	-2.04e-6
6	1	P7-3A	0	0	0	0	0	1.443e-5
7	1	P6-3A	0	0	0	0	0	-3.546e-5
8	1	P6-3A-FTG	0	0	0	0	0	0
9	1	P5-3A	0	0	0	0	0	1.485e-4
10	1	P5-3A-FTG	0	0	0	0	0	0
11	1	H3	.639	.018	0	0	0	6.737e-4
12	1	P4-3A	.639	0	0	0	0	-1.852e-3
13	1	P4-3A-FTG	0	0	0	0	0	0
14	1	P3-3A	.639	0	0	0	0	4.529e-4
15	1	P3-3A-FTG	0	0	0	0	0	0
16	1	P2-3A	.639	0	0	0	0	-9.766e-5
17	1	P1-3A	.639	0	0	0	0	4.005e-5
18	1	H5	0	0	0	0	0	-3.726e-6
19	1	H4	0	.002	0	0	0	-3.726e-6
20	1	N16	0	0	0	0	0	-1.349e-8
21	1	N17	0	0	0	0	0	-3.144e-8
22	1	N18	0	0	0	0	0	1.591e-7
23	1	N19	0	0	0	0	0	6.936e-8
24	1	N20	0	0	0	0	0	1.365e-8
25	1	N21	0	0	0	0	0	-6.931e-8
26	1	N22	0	0	0	0	0	-5.907e-8
27	1	N23	0	0	0	0	0	-7.313e-7
28	1	N24	0	0	0	0	0	-1.787e-7
29	1	N25	0	0	0	0	0	2.777e-7
30	1	N26	0	0	0	0	0	2.548e-7
31	1	N27	0	0	0	0	0	-1.641e-6
32	1	N28	0	0	0	0	0	-1.186e-6
33	1	N29	0	.004	0	0	0	-2.365e-5
34	1	N30	0	.006	0	0	0	-5.687e-6
35	1	N31	0	.001	0	0	0	1.356e-5
36	1	N32	0	-.01	0	0	0	7.353e-5
37	1	N33	0	-.01	0	0	0	-4.097e-5
38	1	N34	0	-.005	0	0	0	-4.325e-5
39	1	N35	.639	.115	0	0	0	-1.378e-3
40	1	N36	.639	.195	0	0	0	-5.6e-4
41	1	N37	.639	-.038	0	0	0	5.62e-4
42	1	N38	.639	-.09	0	0	0	6.14e-4
43	1	N39	.639	-.223	0	0	0	-3.266e-4
44	1	N40	.639	-.205	0	0	0	-7.197e-4
45	1	N41	.639	-.147	0	0	0	-1.255e-3
46	1	N42	.639	.008	0	0	0	-1.205e-4
47	1	N43	.639	.016	0	0	0	-1.32e-4
48	1	N44	.639	.045	0	0	0	1.025e-4
49	1	N45	.639	.034	0	0	0	2.709e-4
50	1	N46	.639	-.004	0	0	0	3.407e-5
51	1	N47	.639	-.01	0	0	0	-1.222e-5
52	1	N48	.639	-.007	0	0	0	-5.952e-5



LHB

jdf

090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

May 10, 2010 at 3:07 PM

090147_3A_P4_GirderABeamA_PierRotation.r3d

I-26

5/10/10

Global

Display Sections for Member Calcs	3
Max Internal Sections for Member Calcs	99
Include Shear Deformation	Yes
Include Warping	No
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Vertical Axis	Y

Calculation used
 to determine
 P4-3A support
 Spring constants.

Hot Rolled Steel Code	AISC : ASD 13th (Direct Analysis Method)
Cold Formed Steel Code	AISI 01: ASD
Wood Code	NDS 2005: ASD
Wood Temperature	< 100F
Concrete Code	ACI 2005
Masonry Code	MSJC 05/IBC 06 ASD

Number of Shear Regions	4
Region Spacing Increment (in)	4
Biaxial Column Method	Exact Integration
Paralle Beta Factor (PCA)	.65
Concrete Stress Block	Rectangular
Use Cracked Sections	Yes
Bad Framing Warnings	No
Unused Force Warnings	Yes

Footing Overturning Safety Factor	1.5
Check Concrete Bearing	Yes
Self Wt, Overburden in DL for Design	Yes
Footing Concrete Weight	.145 k/ft^3
Footing Concrete f _c	3 ksi
Footing Concrete E _c	4000 ksi
Footing Steel f _y	60 ksi
Minimum Steel	0.0018
Maximum Steel	0.0075
Footing Top Bar	#3
Footing Top Bar Cover	3.5 in
Footing Bottom Bar	#4
Footing Bottom Bar Cover	3.5 in
Pedestal Bar	#3
Pedestal Bar Cover	1.5 in
Pedestal Ties	#3

General Material Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (1/E5 F)	Density[k/ft^3]
1	gen Conc4NW	3644	1584	.15	.6	.145
2	gen Alum	10600	4077	.3	1.29	.173
3	gen Steel	29000	11154	.3	.65	.49
4	RIGID	1e+6		.3	0	0

Member Primary Data ✓

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1-1	H1	N16			I25303	Beam	None	gen_Steel	Typical
2	M1-2		N16	N17		I10817	Beam	None	gen_Steel	Typical
3	M1-3		N17	P3-3C		I16734	Beam	None	gen_Steel	Typical
4	M2-1	P3-3C		N22		I16734	Beam	None	gen_Steel	Typical

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Member Primary Data (Continued)

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
5	M2-2	N22	N21			I09514	Beam	None	gen_Steel	Typical
6	M2-3	N21	N20			I25309	Beam	None	gen_Steel	Typical
7	M2-4	N20	N19			I09514	Beam	None	gen_Steel	Typical
8	M2-5	N19	N18			I13797	Beam	None	gen_Steel	Typical
9	M2-6	N18	P2-3C			I22809	Beam	None	gen_Steel	Typical
10	M3-1	P2-3C	N26			I22809	Beam	None	gen_Steel	Typical
11	M3-2	N26	N25			I10926	Beam	None	gen_Steel	Typical
12	M3-3	N25	N24			I36658	Beam	None	gen_Steel	Typical
13	M3-4	N24	N23			I10926	Beam	None	gen_Steel	Typical
14	M3-5	N23	P1-3C			I24370	Beam	None	gen_Steel	Typical
15	M4-1	P1-3C	N28			I24370	Beam	None	gen_Steel	Typical
16	M4-2	N28	N27			I16734	Beam	None	gen_Steel	Typical
17	M4-3	N27	H2			I29974	Beam	None	gen_Steel	Typical
18	M5-1	H2	P7-3A			I15454	Beam	None	gen_Steel	Typical
19	M6-1	P7-3A	N31			I15454	Beam	None	gen_Steel	Typical
20	M6-2	N31	N30			I41499	Beam	None	gen_Steel	Typical
21	M6-3	N30	N29			I19738	Beam	None	gen_Steel	Typical
22	M6-4	N29	P6-3A			I29157	Beam	None	gen_Steel	Typical
23	M7-1	P6-3A	N34			I29157	Beam	None	gen_Steel	Typical
24	M7-2	N34	N33			I22809	Beam	None	gen_Steel	Typical
25	M7-3	N33	N32			I46018	Beam	None	gen_Steel	Typical
26	M7-4	N32	P5-3A			I19603	Beam	None	gen_Steel	Typical
27	M8-1	P5-3A	H3			I19603	Beam	None	gen_Steel	Typical
28	M9-1	H3	N36			I28777	Beam	None	gen_Steel	Typical
29	M9-2	N36	N35			I11986	Beam	None	gen_Steel	Typical
30	M9-3	N35	P4-3A			I19714	Beam	None	gen_Steel	Typical
31	M10-1	P4-3A	N41			I19714	Beam	None	gen_Steel	Typical
32	M10-2	N41	N40			I11986	Beam	None	gen_Steel	Typical
33	M10-3	N40	N39			I08894	Beam	None	gen_Steel	Typical
34	M10-4	N39	N38			I22816	Beam	None	gen_Steel	Typical
35	M10-5	N38	N37			I08120	Beam	None	gen_Steel	Typical
36	M10-6	N37	P3-3A			I13782	Beam	None	gen_Steel	Typical
37	M11-1	P3-3A	N45			I13782	Beam	None	gen_Steel	Typical
38	M11-2	N45	N44			I08120	Beam	None	gen_Steel	Typical
39	M11-3	N44	N43			I22984	Beam	None	gen_Steel	Typical
40	M11-4	N43	N42			I08120	Beam	None	gen_Steel	Typical
41	M11-5	N42	P2-3A			I13782	Beam	None	gen_Steel	Typical
42	M12-1	P2-3A	N48			I13782	Beam	None	gen_Steel	Typical
43	M12-2	N48	N47			I07151	Beam	None	gen_Steel	Typical
44	M12-3	N47	N46			I21244	Beam	None	gen_Steel	Typical
45	M12-4	N46	P1-3A			I07151	Beam	None	gen_Steel	Typical
46	M13-1	P1-3A	H4			I07151	Beam	None	gen_Steel	Typical
47	M14-1	H4	H5			I34141	Beam	None	gen_Steel	Typical
48	M4-3A-COL	P4-3A-FTG	P4-3A			CRND60	Column	None	Conc4000...	Typical
49	M3-3A-COL	P3-3A-FTG	P3-3A			CRND54	Column	None	Conc4000...	Typical
50	M6-3A-COL	P6-3A-FTG	P6-3A			P6-3A-Pier	Column	None	gen_Conc...	Typical
51	M5-3A-COL	P5-3A-FTG	P5-3A			P5-3A-Pier	Column	None	gen_Conc...	Typical

Member Advanced Data

	Label	I Release	J Release	I Offset[in]	J Offset[in]	T/C Only	Physical	TOM	Inactive
1	M1-1						Yes		
2	M1-2						Yes		
3	M1-3						Yes		
4	M2-1						Yes		
5	M2-2						Yes		
6	M2-3						Yes		

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Member Advanced Data (Continued) ✓

	Label	I Release	J Release	I Offset[in]	J Offset[in]	T/C Only	Physical	TOM	Inactive
7	M2-4						Yes		
8	M2-5						Yes		
9	M2-6						Yes		
10	M3-1						Yes		
11	M3-2						Yes		
12	M3-3						Yes		
13	M3-4						Yes		
14	M3-5						Yes		
15	M4-1						Yes		
16	M4-2						Yes		
17	M4-3						Yes		
18	M5-1	XOOOXX					Yes		
19	M6-1						Yes		
20	M6-2						Yes		
21	M6-3						Yes		
22	M6-4						Yes		
23	M7-1						Yes		
24	M7-2						Yes		
25	M7-3						Yes		
26	M7-4						Yes		
27	M8-1		XOOOXX				Yes		
28	M9-1						Yes		
29	M9-2						Yes		
30	M9-3						Yes		
31	M10-1						Yes		
32	M10-2						Yes		
33	M10-3						Yes		
34	M10-4						Yes		
35	M10-5						Yes		
36	M10-6						Yes		
37	M11-1						Yes		
38	M11-2						Yes		
39	M11-3						Yes		
40	M11-4						Yes		
41	M11-5						Yes		
42	M12-1						Yes		
43	M12-2						Yes		
44	M12-3						Yes		
45	M12-4						Yes		
46	M13-1		XOOOXX				Yes		
47	M14-1						Yes		
48	M4-3A-COL						Yes		
49	M3-3A-COL		BenPIN				Yes		
50	M6-3A-COL		BenPIN				Yes		
51	M5-3A-COL		BenPIN				Yes		

Joint Coordinates and Temperatures ✓

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
1	H1	0	0	0	0	
2	P3-3C	65.02	0	0	0	
3	P2-3C	146.04	0	0	0	
4	P1-3C	241.87	0	0	0	
5	H2	308.47	0	0	0	
6	P7-3A	316.47	0	0	0	
7	P6-3A	399.1	0	0	0	
8	P6-3A-FTG	399.1	-34.2	0	0	

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

May 10, 2010
 3:08 PM
 Checked By: *CSM*

5/10/10

Joint Coordinates and Temperatures (Continued) ✓

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
9	P5-3A	482.07	0	0	0	
10	P5-3A-FTG	482.07	-30.42	0	0	
11	H3	490.07	0	0	0	
12	P4-3A	557.06	0	0	0	
13	P4-3A-FTG	557.06	-33.75	0	0	
14	P3-3A	622.94	0	0	0	
15	P3-3A-FTG	622.94	-31.04	0	0	
16	P2-3A	689.22	0	0	0	
17	P1-3A	742.42	0	0	0	
18	H5	802.8	0	0	0	
19	H4	747.56	0	0	0	
20	N16	52.02	0	0	0	
21	N17	58.02	0	0	0	
22	N18	138.04	0	0	0	
23	N19	128.04	0	0	0	
24	N20	123.04	0	0	0	
25	N21	81.02	0	0	0	
26	N22	72.02	0	0	0	
27	N23	232.87	0	0	0	
28	N24	222.87	0	0	0	
29	N25	165.04	0	0	0	
30	N26	155.04	0	0	0	
31	N27	261.87	0	0	0	
32	N28	248.87	0	0	0	
33	N29	389.1	0	0	0	
34	N30	377.1	0	0	0	
35	N31	324.47	0	0	0	
36	N32	474.07	0	0	0	
37	N33	419.1	0	0	0	
38	N34	409.1	0	0	0	
39	N35	551.06	0	0	0	
40	N36	544.06	0	0	0	
41	N37	616.94	0	0	0	
42	N38	609.94	0	0	0	
43	N39	573.06	0	0	0	
44	N40	570.06	0	0	0	
45	N41	565.06	0	0	0	
46	N42	683.22	0	0	0	
47	N43	678.22	0	0	0	
48	N44	635.94	0	0	0	
49	N45	630.94	0	0	0	
50	N46	734.42	0	0	0	
51	N47	703.22	0	0	0	
52	N48	697.22	0	0	0	

Joint Boundary Conditions

will only minorly affect. will not carry through

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot.[k-ft/rad]	Y Rot.[k-ft/rad]	Z Rot.[k-ft/rad]	Footing
1	H1	Reaction	Reaction	Reaction	Reaction			
2	P3-3C		Reaction	Reaction	Reaction			
3	P2-3C		Reaction	Reaction	Reaction			
4	P1-3C		Reaction	Reaction	Reaction			
5	P7-3A	<i>200.14</i>	Reaction	Reaction	Reaction			
6	P6-3A-FTG	<i>S100.2</i>	Reaction	Reaction	Reaction	Reaction	Reaction	
7	P5-3A-FTG	<i>S221</i>	Reaction	Reaction	Reaction	Reaction	Reaction	
8	P4-3A-FTG	Reaction ✓	Reaction	Reaction	Reaction	Reaction	Reaction	
9	P3-3A-FTG	<i>S114.6</i> ✓	Reaction	Reaction	Reaction	Reaction	Reaction	

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

May 10, 2010
 3:08 PM
 Checked By: *CSM*

5/10/10

Joint Boundary Conditions (Continued) ✓

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot [k-ft/rad]	Y Rot [k-ft/rad]	Z Rot [k-ft/rad]	Footing
10	P2-3A		Reaction	Reaction	Reaction			
11	P1-3A		Reaction	Reaction	Reaction			
12	H5	Reaction	Reaction	Reaction	Reaction			

Joint Loads and Enforced Displacements (BLC 2 : Unit Moment) ✓

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft...]
1	P4-3A	L	Mz	1

Basic Load Cases ✓

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distributed	Area (M... Surface (...]
2	Unit Moment	None				1			

Load Combinations ✓

	Description	Sol... PD... SR...	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor
1	Z-Rotation	Yes	2	100							

5/10/10

Joint Deflections (By Combination)

	LC	Joint Label	X [in]	Y [in]	Z [in]	X Rotation [rad]	Y Rotation [rad]	Z Rotation [rad]
1	1	H1	0	0	0	0	0	0
2	1	P3-3C	0	0	0	0	0	0
3	1	P2-3C	0	0	0	0	0	-1.41e-8
4	1	P1-3C	0	0	0	0	0	6.623e-8
5	1	H2	0	0	0	0	0	1.369e-7
6	1	P7-3A	0	0	0	0	0	-9.687e-7
7	1	P6-3A	0	0	0	0	0	2.385e-6
8	1	P6-3A-FTG	0	0	0	0	0	0
9	1	P5-3A	0	0	0	0	0	-1.002e-5
10	1	P5-3A-FTG	0	0	0	0	0	0
11	1	H3	-.022	-.001	0	0	0	-4.539e-5
12	1	P4-3A	-.022	0	0	0	0	1.248e-4
13	1	P4-3A-FTG	0	0	0	0	0	0
14	1	P3-3A	-.022	0	0	0	0	-3.052e-5
15	1	P3-3A-FTG	-.008	0	0	0	0	0
16	1	P2-3A	-.022	0	0	0	0	6.561e-6
17	1	P1-3A	-.022	0	0	0	0	-2.69e-6
18	1	H5	0	0	0	0	0	2.503e-7
19	1	H4	0	0	0	0	0	2.503e-7
20	1	N16	0	0	0	0	0	0
21	1	N17	0	0	0	0	0	0
22	1	N18	0	0	0	0	0	-1.068e-8
23	1	N19	0	0	0	0	0	0
24	1	N20	0	0	0	0	0	0
25	1	N21	0	0	0	0	0	0
26	1	N22	0	0	0	0	0	0
27	1	N23	0	0	0	0	0	4.908e-8
28	1	N24	0	0	0	0	0	1.2e-8
29	1	N25	0	0	0	0	0	-1.864e-8
30	1	N26	0	0	0	0	0	-1.71e-8
31	1	N27	0	0	0	0	0	1.101e-7
32	1	N28	0	0	0	0	0	7.963e-8
33	1	N29	0	0	0	0	0	1.591e-6
34	1	N30	0	0	0	0	0	3.836e-7
35	1	N31	0	0	0	0	0	-9.098e-7
36	1	N32	0	0	0	0	0	-4.967e-6
37	1	N33	0	0	0	0	0	2.752e-6
38	1	N34	0	0	0	0	0	2.908e-6
39	1	N35	-.022	-.008	0	0	0	9.287e-5
40	1	N36	-.022	-.013	0	0	0	3.775e-5
41	1	N37	-.022	.003	0	0	0	-3.786e-5
42	1	N38	-.022	.006	0	0	0	-4.135e-5
43	1	N39	-.022	.015	0	0	0	2.204e-5
44	1	N40	-.022	.014	0	0	0	4.852e-5
45	1	N41	-.022	.01	0	0	0	8.457e-5
46	1	N42	-.022	0	0	0	0	8.096e-6
47	1	N43	-.022	-.001	0	0	0	8.86e-6
48	1	N44	-.022	-.003	0	0	0	-6.931e-6
49	1	N45	-.022	-.002	0	0	0	-1.827e-5
50	1	N46	-.022	0	0	0	0	-2.289e-6
51	1	N47	-.022	0	0	0	0	8.212e-7
52	1	N48	-.022	0	0	0	0	3.998e-6

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Joint Deflections (By Combination)

	LC	Joint Label	X [in]	Y [in]	Z [in]	X Rotation [rad]	Y Rotation [rad]	Z Rotation [rad]
1	7	N2	0	0	0	2.533e-8	0	0
2	7	N3	0	0	0	0	0	0
3	7	N4	0	0	0	0	0	0
4	7	N5	0	0	0	1.829e-4	-4.465e-6	0
5	7	N6	0	0	-0.002	7.893e-4	-1.927e-5	0
6	7	N11	0	0	0	2.533e-8	-5.619e-8	0
7	7	N12	0	0	0	2.533e-8	-5.619e-8	0
8	7	N13	0	0	0	0	-5.961e-3	0
9	7	N15	0	0	0	1.829e-4	-5.433e-3	0
10	7	N16	0	0	-0.002	7.893e-4	-2.883e-5	0
11	7	N17	0	0	-0.002	7.893e-4	-2.883e-5	0

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

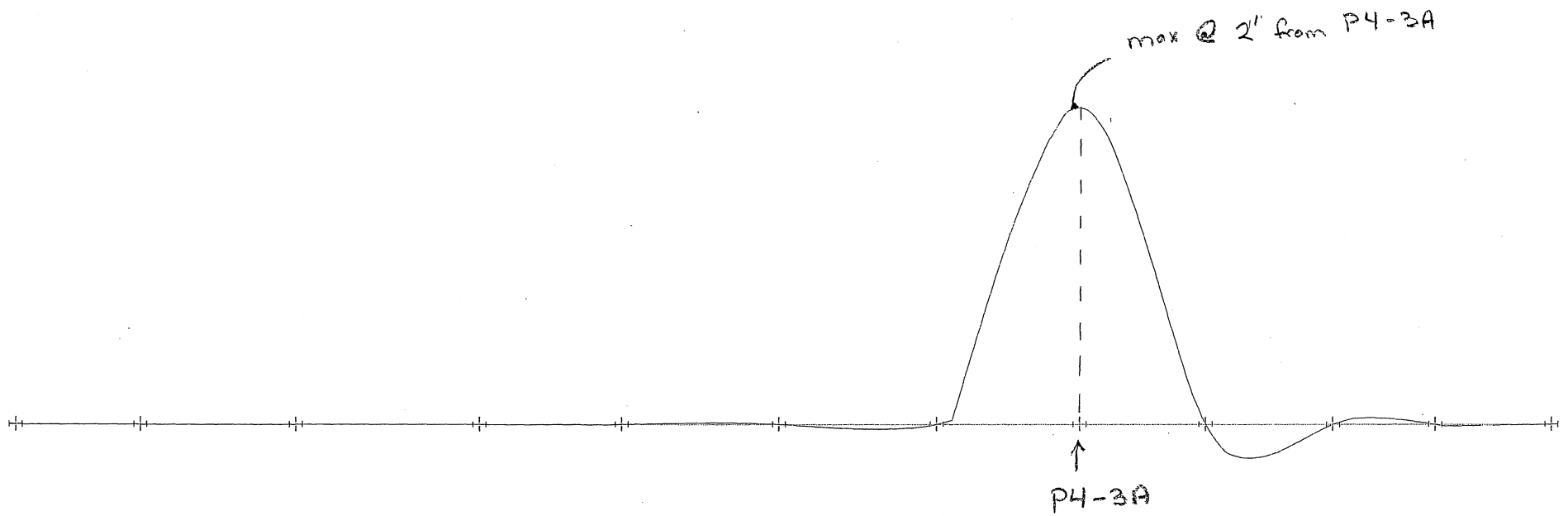
Mar 9, 2010
 8:49 AM
 Checked By: *asm*

5/10/10

Joint Boundary Conditions

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot.[k-ft/rad]	Y Rot.[k-ft/rad]	Z Rot.[k-ft/rad]	Footing
1	H1	Reaction	Reaction	Reaction	Reaction			
2	P3-3C		Reaction	Reaction	Reaction			
3	P2-3C		Reaction	Reaction	Reaction			
4	P1-3C		Reaction	Reaction	Reaction			
5	P7-3A		Reaction	Reaction	Reaction			
6	P6-3A-FTG	S100.2	Reaction	Reaction	Reaction	Reaction	Reaction	
7	P5-3A-FTG	S221	Reaction	Reaction	Reaction	Reaction	Reaction	
8	P4-3A-FTG	S143.2 ✓	Reaction	Reaction	Reaction	Reaction	Reaction	
9	P4-3A	S64.5 ✓	Reaction	Reaction	Reaction	Reaction	S109398 ✓	
10	P3-3A-FTG	S114.6 ✓	Reaction	Reaction	Reaction	Reaction	Reaction	
11	P2-3A		Reaction	Reaction	Reaction			
12	P1-3A		Reaction	Reaction	Reaction			
13	H5	Reaction	Reaction	Reaction	Reaction			

EL



Influence Line for Reaction at P4-3A

LHB

jdf

090147

Pier 4,5,6-3A, Girder A and Beam A

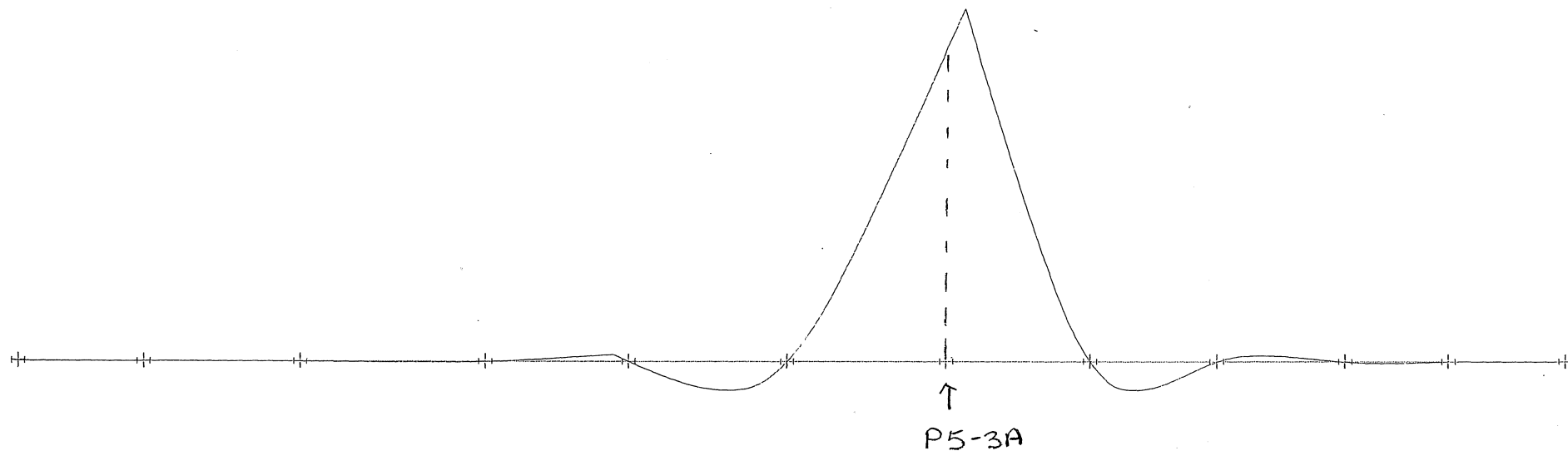
Dec 11, 2009 at 4:18 PM

090147_3A_P456_GirderABeamA.r3d

vcsm 4/28/10

I-35

EL



Influence Line for Reaction at P5-3A

LHB

jdf

090147

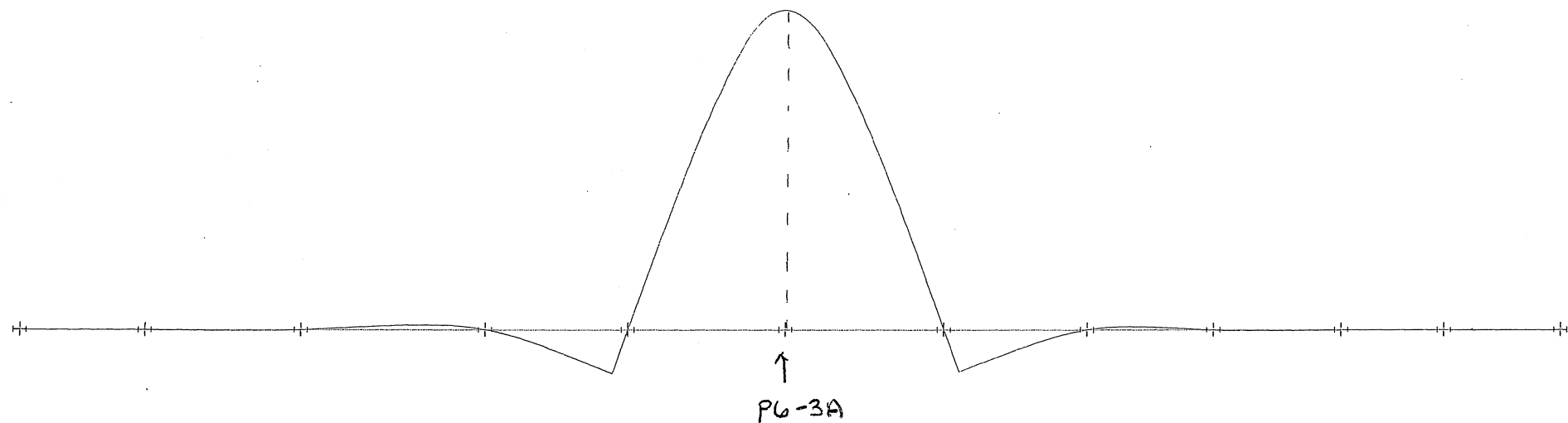
Pier 4,5,6-3A, Girder A and Beam A

Dec 11, 2009 at 4:19 PM

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EL



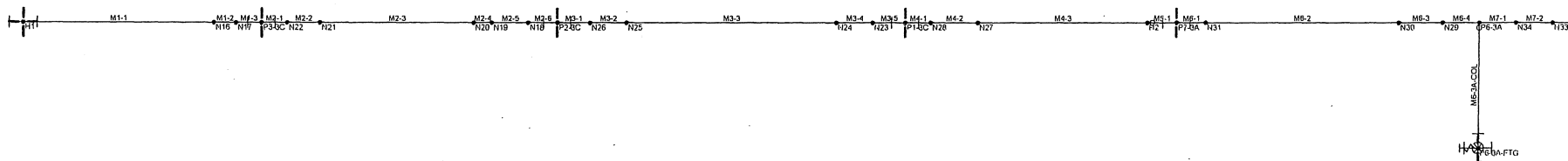
Influence Line for Reaction at P6-3A

Results for EC 11, P6-3A Influence

LHB	Pier 4,5,6-3A, Girder A and Beam A	
jdf		Dec 11, 2009 at 4:19 PM
090147		090147_3A_P456_GirderABeamA.r3d

105m 4/28/10

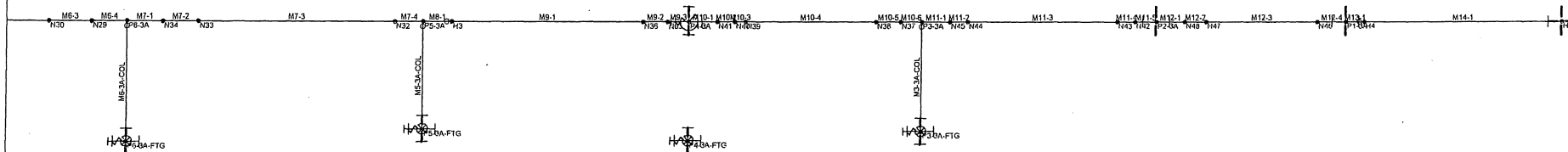
I-37



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next page

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previous page

LHB

jdf

090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

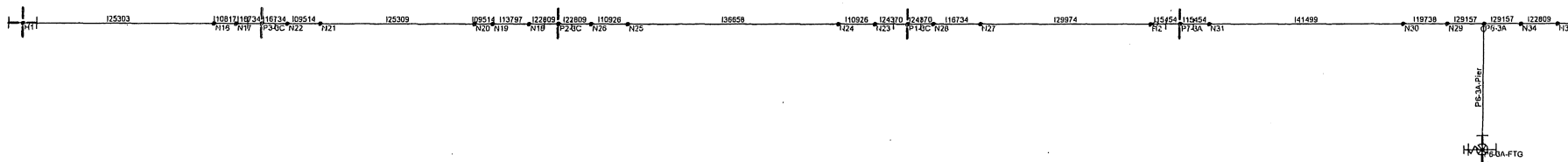
Node and Member Layout

Mar 9, 2010 at 9:03 AM

090147_3A_P456_GirderABeamA.r3d

65-1

Y
Z L X



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LHB

jdf

090147

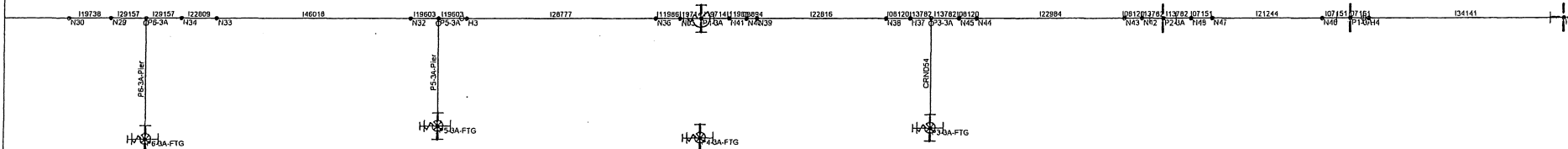
Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Shape Labels

Mar 9, 2010 at 9:05 AM

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previous page

090147

090147_3A_P456_GirderABeamA.r3d

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Global

Display Sections for Member Calcs	3
Max Internal Sections for Member Calcs	99
Include Shear Deformation	Yes
Include Warping	No
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Vertical Axis	Y

Hot Rolled Steel Code	AISC : ASD 13th (Direct Analysis Method)
Cold Formed Steel Code	AISI 01: ASD
Wood Code	NDS 2005: ASD
Wood Temperature	< 100F
Concrete Code	ACI 2005
Masonry Code	MSJC 05/IBC 06 ASD

Number of Shear Regions	4
Region Spacing Increment (in)	4
Biaxial Column Method	Exact Integration
Parme Beta Factor (PCA)	.65
Concrete Stress Block	Rectangular
Use Cracked Sections	Yes
Bad Framing Warnings	No
Unused Force Warnings	Yes

Footing Overturning Safety Factor	1.5
Check Concrete Bearing	Yes
Self Wt. Overburden in DL for Design	Yes
Footing Concrete Weight	.145 k/ft^3
Footing Concrete f _c	3 ksi
Footing Concrete E _c	4000 ksi
Footing Steel f _y	60 ksi
Minimum Steel	0.0018
Maximum Steel	0.0075
Footing Top Bar	#3
Footing Top Bar Cover	3.5 in
Footing Bottom Bar	#4
Footing Bottom Bar Cover	3.5 in
Pedestal Bar	#3
Pedestal Bar Cover	1.5 in
Pedestal Ties	#3

General Material Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (1/E5 F)	Density[k/ft^3]
1	gen Conc4NW	3644	1584	.15	.6	.145
2	gen Alum	10600	4077	.3	1.29	.173
3	gen Steel	29000	11154	.3	.65	.49
4	RIGID	1e+6		.3	0	0

Member Primary Data

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1-1	H1	N16			I25303	Beam	None	gen_Steel	Typical
2	M1-2	N16	N17			I10817	Beam	None	gen_Steel	Typical
3	M1-3	N17	P3-3C			I16734	Beam	None	gen_Steel	Typical
4	M2-1	P3-3C	N22			I16734	Beam	None	gen_Steel	Typical

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Member Primary Data (Continued)

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
5	M2-2	N22	N21			I09514	Beam	None	gen_Steel	Typical
6	M2-3	N21	N20			I25309	Beam	None	gen_Steel	Typical
7	M2-4	N20	N19			I09514	Beam	None	gen_Steel	Typical
8	M2-5	N19	N18			I13797	Beam	None	gen_Steel	Typical
9	M2-6	N18	P2-3C			I22809	Beam	None	gen_Steel	Typical
10	M3-1	P2-3C	N26			I22809	Beam	None	gen_Steel	Typical
11	M3-2	N26	N25			I10926	Beam	None	gen_Steel	Typical
12	M3-3	N25	N24			I36658	Beam	None	gen_Steel	Typical
13	M3-4	N24	N23			I10926	Beam	None	gen_Steel	Typical
14	M3-5	N23	P1-3C			I24370	Beam	None	gen_Steel	Typical
15	M4-1	P1-3C	N28			I24370	Beam	None	gen_Steel	Typical
16	M4-2	N28	N27			I16734	Beam	None	gen_Steel	Typical
17	M4-3	N27	H2			I29974	Beam	None	gen_Steel	Typical
18	M5-1	H2	P7-3A			I15454	Beam	None	gen_Steel	Typical
19	M6-1	P7-3A	N31			I15454	Beam	None	gen_Steel	Typical
20	M6-2	N31	N30			I41499	Beam	None	gen_Steel	Typical
21	M6-3	N30	N29			I19738	Beam	None	gen_Steel	Typical
22	M6-4	N29	P6-3A			I29157	Beam	None	gen_Steel	Typical
23	M7-1	P6-3A	N34			I29157	Beam	None	gen_Steel	Typical
24	M7-2	N34	N33			I22809	Beam	None	gen_Steel	Typical
25	M7-3	N33	N32			I46018	Beam	None	gen_Steel	Typical
26	M7-4	N32	P5-3A			I19603	Beam	None	gen_Steel	Typical
27	M8-1	P5-3A	H3			I19603	Beam	None	gen_Steel	Typical
28	M9-1	H3	N36			I28777	Beam	None	gen_Steel	Typical
29	M9-2	N36	N35			I11986	Beam	None	gen_Steel	Typical
30	M9-3	N35	P4-3A			I19714	Beam	None	gen_Steel	Typical
31	M10-1	P4-3A	N41			I19714	Beam	None	gen_Steel	Typical
32	M10-2	N41	N40			I11986	Beam	None	gen_Steel	Typical
33	M10-3	N40	N39			I08894	Beam	None	gen_Steel	Typical
34	M10-4	N39	N38			I22816	Beam	None	gen_Steel	Typical
35	M10-5	N38	N37			I08120	Beam	None	gen_Steel	Typical
36	M10-6	N37	P3-3A			I13782	Beam	None	gen_Steel	Typical
37	M11-1	P3-3A	N45			I13782	Beam	None	gen_Steel	Typical
38	M11-2	N45	N44			I08120	Beam	None	gen_Steel	Typical
39	M11-3	N44	N43			I22984	Beam	None	gen_Steel	Typical
40	M11-4	N43	N42			I08120	Beam	None	gen_Steel	Typical
41	M11-5	N42	P2-3A			I13782	Beam	None	gen_Steel	Typical
42	M12-1	P2-3A	N48			I13782	Beam	None	gen_Steel	Typical
43	M12-2	N48	N47			I07151	Beam	None	gen_Steel	Typical
44	M12-3	N47	N46			I21244	Beam	None	gen_Steel	Typical
45	M12-4	N46	P1-3A			I07151	Beam	None	gen_Steel	Typical
46	M13-1	P1-3A	H4			I07151	Beam	None	gen_Steel	Typical
47	M14-1	H4	H5			I34141	Beam	None	gen_Steel	Typical
48	M4-3A-COL	P4-3A-FTG	P4-3A			CRND60	Column	None	Conc4000...	Typical
49	M3-3A-COL	P3-3A-FTG	P3-3A			CRND54	Column	None	Conc4000...	Typical
50	M6-3A-COL	P6-3A-FTG	P6-3A			P6-3A-Pier	Column	None	gen_Conc...	Typical
51	M5-3A-COL	P5-3A-FTG	P5-3A			P5-3A-Pier	Column	None	gen_Conc...	Typical

Member Advanced Data

	Label	I Release	J Release	I Offset[in]	J Offset[in]	T/C Only	Physical	TOM	Inactive
1	M1-1						Yes		
2	M1-2						Yes		
3	M1-3						Yes		
4	M2-1						Yes		
5	M2-2						Yes		
6	M2-3						Yes		

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Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 26, 2010
 11:36 AM
 Checked By: CJM

5/6/10

Member Advanced Data (Continued) ✓

	Label	I Release	J Release	I Offset[in]	J Offset[in]	T/C Only	Physical	TOM	Inactive
7	M2-4						Yes		
8	M2-5						Yes		
9	M2-6						Yes		
10	M3-1						Yes		
11	M3-2						Yes		
12	M3-3						Yes		
13	M3-4						Yes		
14	M3-5						Yes		
15	M4-1						Yes		
16	M4-2						Yes		
17	M4-3						Yes		
18	M5-1	XOOOXX					Yes		
19	M6-1						Yes		
20	M6-2						Yes		
21	M6-3						Yes		
22	M6-4						Yes		
23	M7-1						Yes		
24	M7-2						Yes		
25	M7-3						Yes		
26	M7-4						Yes		
27	M8-1		XOOOXX				Yes		
28	M9-1						Yes		
29	M9-2						Yes		
30	M9-3						Yes		
31	M10-1						Yes		
32	M10-2						Yes		
33	M10-3						Yes		
34	M10-4						Yes		
35	M10-5						Yes		
36	M10-6						Yes		
37	M11-1						Yes		
38	M11-2						Yes		
39	M11-3						Yes		
40	M11-4						Yes		
41	M11-5						Yes		
42	M12-1						Yes		
43	M12-2						Yes		
44	M12-3						Yes		
45	M12-4						Yes		
46	M13-1		XOOOXX				Yes		
47	M14-1						Yes		
48	M4-3A-COL						Yes		Inactive
49	M3-3A-COL		BenPIN				Yes		
50	M6-3A-COL		BenPIN				Yes		
51	M5-3A-COL		BenPIN				Yes		

Joint Coordinates and Temperatures ✓

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
1	H1	0	0	0	0	
2	P3-3C	65.02	0	0	0	
3	P2-3C	146.04	0	0	0	
4	P1-3C	241.87	0	0	0	
5	H2	308.47	0	0	0	
6	P7-3A	316.47	0	0	0	
7	P6-3A	399.1	0	0	0	
8	P6-3A-FTG	399.1	-34.2	0	0	

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Joint Coordinates and Temperatures (Continued)

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
9	P5-3A	482.07	0	0	0	
10	P5-3A-FTG	482.07	-30.42	0	0	
11	H3	490.07	0	0	0	
12	P4-3A	557.06	0	0	0	
13	P4-3A-FTG	557.06	-33.75	0	0	
14	P3-3A	622.94	0	0	0	
15	P3-3A-FTG	622.94	-31.04	0	0	
16	P2-3A	689.22	0	0	0	
17	P1-3A	742.42	0	0	0	
18	H5	802.8	0	0	0	
19	H4	747.56	0	0	0	
20	N16	52.02	0	0	0	
21	N17	58.02	0	0	0	
22	N18	138.04	0	0	0	
23	N19	128.04	0	0	0	
24	N20	123.04	0	0	0	
25	N21	81.02	0	0	0	
26	N22	72.02	0	0	0	
27	N23	232.87	0	0	0	
28	N24	222.87	0	0	0	
29	N25	165.04	0	0	0	
30	N26	155.04	0	0	0	
31	N27	261.87	0	0	0	
32	N28	248.87	0	0	0	
33	N29	389.1	0	0	0	
34	N30	377.1	0	0	0	
35	N31	324.47	0	0	0	
36	N32	474.07	0	0	0	
37	N33	419.1	0	0	0	
38	N34	409.1	0	0	0	
39	N35	551.06	0	0	0	
40	N36	544.06	0	0	0	
41	N37	616.94	0	0	0	
42	N38	609.94	0	0	0	
43	N39	573.06	0	0	0	
44	N40	570.06	0	0	0	
45	N41	565.06	0	0	0	
46	N42	683.22	0	0	0	
47	N43	678.22	0	0	0	
48	N44	635.94	0	0	0	
49	N45	630.94	0	0	0	
50	N46	734.42	0	0	0	
51	N47	703.22	0	0	0	
52	N48	697.22	0	0	0	

This change will likely cause extremely minor changes in most Reactions. It will affect the horizontal braking force 90's.

Joint Boundary Conditions *will not be carried through.*

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot [k-ft/rad]	Y Rot [k-ft/rad]	Z Rot [k-ft/rad]	Footing
1	H1	Reaction	Reaction	Reaction	Reaction			
2	P3-3C		Reaction	Reaction	Reaction			
3	P2-3C		Reaction	Reaction	Reaction			
4	P1-3C		Reaction	Reaction	Reaction			
5	P7-3A	<i>S200.4</i>	Reaction	Reaction	Reaction			
6	P6-3A-FTG	<i>S100.2</i>	Reaction	Reaction	Reaction	Reaction	Reaction	
7	P5-3A-FTG	S221	Reaction	Reaction	Reaction	Reaction	Reaction	
8	P4-3A-FTG	S143.2	Reaction	Reaction	Reaction	Reaction	Reaction	
9	P4-3A	S64.5	Reaction	Reaction	Reaction	Reaction	S109398	

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Joint Boundary Conditions (Continued)

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot.[k-ft/rad]	Y Rot.[k-ft/rad]	Z Rot.[k-ft/rad]	Footing
10	P3-3A-FTG	S114.6	Reaction	Reaction	Reaction	Reaction	Reaction	
11	P2-3A		Reaction	Reaction	Reaction			
12	P1-3A		Reaction	Reaction	Reaction			
13	H5	Reaction	Reaction	Reaction	Reaction			

Joint Loads and Enforced Displacements (BLC 1 : P4-3A Reaction Influence) ✓

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft..
1	P4-3A	D	Y	1

Joint Loads and Enforced Displacements (BLC 2 : P5-3A Reaction Influence) ✓

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft..
1	P5-3A	D	Y	1

Joint Loads and Enforced Displacements (BLC 3 : P6-3A Reaction Influence) ✓

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft..
1	P6-3A	D	Y	1

Joint Loads and Enforced Displacements (BLC 8 : Horizontal Load) ✓

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft..
1	P4-3A	L	X	1
2	P6-3A	L	X	1

also Run w/ P5-3A

Member Point Loads (BLC 7 : P4-3A 2 Truck at 50 ft) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M10-4	Y	-8	36.8
2	M10-4	Y	-32	22.8
3	M10-4	Y	-32	8.8
4	M9-1	Y	-8	41.79
5	M9-1	Y	-32	27.79
6	M9-1	Y	-32	13.79

Member Point Loads (BLC 9 : P4-3A Truck Max Reaction) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M9-1	Y	-8	47
2	M9-3	Y	-32	0
3	M10-2	Y	-32	0

Member Point Loads (BLC 10 : P4-3A Truck Max Moment) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M9-1	Y	-8	20.5
2	M9-1	Y	-32	34.5
3	M9-1	Y	-32	48.5

Member Point Loads (BLC 12 : P4-3A Type 3 Reac) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M9-2	Y	-17	6
2	M9-3	Y	-17	3
3	M10-2	Y	-14	1

Member Point Loads (BLC 13 : P4-3A Type 3S2-40 Reac) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
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Member Point Loads (BLC 13 : P4-3A Type 3S2-40 Reac) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M10-4	Y	-12	10
2	M10-2	Y	-17	3
3	M10-1	Y	-17	7
4	M9-1	Y	-17	45.99
5	M9-1	Y	-17	41.99

Member Point Loads (BLC 14 : P4-3A Type 3S3 Reac) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M10-4	Y	-13	2.5
2	M10-3	Y	-13	1.5
3	M10-2	Y	-13	2.5
4	M9-1	Y	-16	52.49
5	M9-1	Y	-16	48.49
6	M9-1	Y	-9	38.49

Member Point Loads (BLC 18 : P4-3A SU7 Reac) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M10-2	Y	-8	3.5
2	M10-1	Y	-8	7.5
3	M10-1	Y	-17	3.5
4	M9-3	Y	-17	5.5
5	M9-3	Y	-8	1.5
6	M9-2	Y	-8	4.5
7	M9-1	Y	-11.5	48.49

Member Point Loads (BLC 19 : P4-3A Std A Reac) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M10-4	Y	-16	1
2	M10-3	Y	-16	0
3	M10-2	Y	-16	1
4	M9-2	Y	-16	4
5	M9-2	Y	-16	0
6	M9-1	Y	-16	49.99
7	M9-1	Y	-8	37.99

Member Point Loads (BLC 20 : P4-3A Std B Reac) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M10-4	Y	-16	8
2	M10-3	Y	-20	1
3	M10-2	Y	-20	2
4	M10-1	Y	-20	6
5	M9-1	Y	-20	49.99
6	M9-1	Y	-20	45.99
7	M9-1	Y	-20	41.99

Member Point Loads (BLC 21 : P4-3A Std C Reac) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M10-4	Y	-15	11.5
2	M10-4	Y	-18	1.5
3	M10-3	Y	-18	.5
4	M10-2	Y	-18	1.5
5	M10-1	Y	-18	5.5
6	M9-1	Y	-18	49.49
7	M9-1	Y	-18	45.49
8	M9-1	Y	-18	41.49

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Member Point Loads (BLC 21 : P4-3A Std C Reac) (Continued) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
9	M9-1	Y	-18	37.49

Member Point Loads (BLC 22 : P4-3A P411 Reac) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M10-4	Y	-15	26.5
2	M10-4	Y	-19.2	16.5
3	M10-4	Y	-19.2	12.5
4	M10-4	Y	-19.2	8.5
5	M10-2	Y	-19.2	4.5
6	M10-2	Y	-19.2	.5
7	M9-1	Y	-19.2	40.49
8	M9-1	Y	-19.2	36.49
9	M9-1	Y	-19.2	24.49
10	M9-1	Y	-19.2	20.49
11	M9-1	Y	-19.2	16.49

Member Point Loads (BLC 23 : P4-3A P413 Reac) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M9-1	Y	-20	6
2	M9-1	Y	-20	10
3	M9-1	Y	-20	14
4	M9-1	Y	-20	34
5	M9-1	Y	-20	38
6	M9-1	Y	-20	42
7	M10-2	Y	-20	2.01
8	M10-3	Y	-20	1.01
9	M10-4	Y	-20	2.01
10	M10-4	Y	-20	22.01
11	M10-4	Y	-20	26.01
12	M10-4	Y	-20	30.01
13	M10-5	Y	-15	3.13

Member Point Loads (BLC 24 : P4-3A C152b Reac) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M10-4	Y	-16	9.5
2	M10-4	Y	-21.4	0
3	M10-2	Y	-21.4	4
4	M10-2	Y	-21.4	0
5	M9-1	Y	-18	51.49
6	M9-1	Y	-18	47.49
7	M9-1	Y	-18	43.49
8	M9-1	Y	-18	39.49

Member Point Loads (BLC 25 : P4-3A C174b Reac) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M10-4	Y	-14	16.5
2	M10-4	Y	-20	5.5
3	M10-4	Y	-20	1
4	M10-2	Y	-20	1.25
5	M10-1	Y	-20	4.75
6	M9-1	Y	-20	49.74
7	M9-1	Y	-20	45.24
8	M9-1	Y	-20	37.49
9	M9-1	Y	-20	32.99

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 26, 2010
 11:36 AM
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Member Point Loads (BLC 26 : P4-3A C198 23 Reac) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M10-4	Y	-14	24
2	M10-4	Y	-23	13
3	M10-4	Y	-23	8.5
4	M10-2	Y	-23	3
5	M10-1	Y	-23	6.5
6	M9-1	Y	-23	47.49
7	M9-1	Y	-23	42.99
8	M9-1	Y	-23	29.49
9	M9-1	Y	-23	24.99

Member Point Loads (BLC 27 : P4-3A C214b Reac) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M10-4	Y	-14	28.5
2	M10-4	Y	-20	17.5
3	M10-4	Y	-20	13
4	M10-4	Y	-20	33
5	M10-2	Y	-20	3.83
6	M10-1	Y	-20	7.33
7	M9-1	Y	-20	45.32
8	M9-1	Y	-20	40.82
9	M9-1	Y	-20	36.32
10	M9-1	Y	-20	23.65
11	M9-1	Y	-20	19.15

Member Point Loads (BLC 28 : P4-3A C237b Reac) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M10-4	Y	-13	35.88
2	M10-4	Y	-18.7	24.88
3	M10-4	Y	-18.7	20.38
4	M10-4	Y	-18.7	15.88
5	M10-4	Y	-18.7	1.88
6	M10-3	Y	-18.7	.38
7	M10-2	Y	-18.7	.88
8	M9-1	Y	-18.7	42.37
9	M9-1	Y	-18.7	37.87
10	M9-1	Y	-18.7	33.37
11	M9-1	Y	-18.7	19.37
12	M9-1	Y	-18.7	14.87
13	M9-1	Y	-18.7	10.37

Member Point Loads (BLC 29 : P4-3A C256b Reac) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M10-5	Y	-16	3
2	M10-4	Y	-20	28.88
3	M10-4	Y	-20	23.88
4	M10-4	Y	-20	18.88
5	M10-4	Y	-20	3.21
6	M10-3	Y	-20	1.21
7	M10-2	Y	-20	1.21
8	M9-1	Y	-20	40.2
9	M9-1	Y	-20	35.2
10	M9-1	Y	-20	30.2
11	M9-1	Y	-20	14.53
12	M9-1	Y	-20	9.53
13	M9-1	Y	-20	4.53

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Member Point Loads (BLC 30 : P4-3A C200j Reac) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M9-1	Y	-20	19
2	M9-1	Y	-20	32.5
3	M9-1	Y	-20	44.5
4	M9-2	Y	-20	1.01
5	M9-3	Y	-20	3.01
6	M10-1	Y	-20	1.51
7	M10-1	Y	-20	6.01
8	M10-3	Y	-20	2.51
9	M10-4	Y	-20	11.01
10	M10-4	Y	-20	24.01

Member Point Loads (BLC 31 : P4-3A Type 3 Tor) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M9-1	Y	-14	30
2	M9-1	Y	-17	42
3	M9-1	Y	-17	46

Member Point Loads (BLC 32 : P4-3A Type 3S2-40 Tor) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M9-1	Y	-12	6
2	M9-1	Y	-17	21
3	M9-1	Y	-17	25
4	M9-1	Y	-17	53
5	M9-2	Y	-17	3.01

Member Point Loads (BLC 33 : P4-3A Type 3S3 Tor) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M9-2	Y	-13	2.51
2	M9-1	Y	-13	52.5
3	M9-1	Y	-13	48.5
4	M9-1	Y	-16	23.5
5	M9-1	Y	-16	19.5
6	M9-1	Y	-9	9.5

Member Point Loads (BLC 37 : P4-3A SU7 Tor) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M9-1	Y	-8	52
2	M9-1	Y	-8	48
3	M9-1	Y	-17	44
4	M9-1	Y	-17	40
5	M9-1	Y	-8	36
6	M9-1	Y	-8	32
7	M9-1	Y	-11.5	22

Member Point Loads (BLC 38 : P4-3A Std A Tor) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M9-2	Y	-16	2.01
2	M9-1	Y	-16	52
3	M9-1	Y	-16	48
4	M9-1	Y	-16	30
5	M9-1	Y	-16	26
6	M9-1	Y	-16	22
7	M9-1	Y	-8	10

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 26, 2010
 11:36 AM

Checked By: *GM*

5/12/10

Member Point Loads (BLC 39 : P4-3A Std B Tor) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft. %]
1	M9-1	Y	-16	8.75
2	M9-1	Y	-20	18.75
3	M9-1	Y	-20	22.75
4	M9-1	Y	-20	26.75
5	M9-1	Y	-20	49.75
6	M9-1	Y	-20	53.75
7	M9-2	Y	-20	3.76

Member Point Loads (BLC 40 : P4-3A Std C Tor) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft. %]
1	M9-1	Y	-15	2.5
2	M9-1	Y	-18	12.5
3	M9-1	Y	-18	16.5
4	M9-1	Y	-18	20.5
5	M9-1	Y	-18	24.5
6	M9-1	Y	-18	47.5
7	M9-1	Y	-18	51.5
8	M9-2	Y	-18	1.51
9	M9-2	Y	-18	5.51

Member Point Loads (BLC 41 : P4-3A P411 Tor) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft. %]
1	M9-2	Y	-15	3.01
2	M9-1	Y	-19.2	47
3	M9-1	Y	-19.2	43
4	M9-1	Y	-19.2	39
5	M9-1	Y	-19.2	27
6	M9-1	Y	-19.2	23
7	M7-4	Y	-19.2	4
8	M7-4	Y	-19.2	0
9	M7-3	Y	-19.2	42.97
10	M7-3	Y	-19.2	38.97
11	M7-3	Y	-19.2	34.97

Member Point Loads (BLC 42 : P4-3A P413 Tor) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft. %]
1	M7-3	Y	-20	14.46
2	M7-3	Y	-20	18.46
3	M7-3	Y	-20	22.46
4	M7-3	Y	-20	42.46
5	M7-3	Y	-20	46.46
6	M7-3	Y	-20	50.46
7	M9-1	Y	-20	14.49
8	M9-1	Y	-20	18.49
9	M9-1	Y	-20	22.49
10	M9-1	Y	-20	42.49
11	M9-1	Y	-20	46.49
12	M9-1	Y	-20	50.49
13	M9-2	Y	-15	6.5

Member Point Loads (BLC 43 : P4-3A C152b Tor) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft. %]
1	M9-1	Y	-16	6
2	M9-1	Y	-21.4	15.5
3	M9-1	Y	-21.4	19.5
4	M9-1	Y	-21.4	23.5

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Member Point Loads (BLC 43 : P4-3A C152b Tor) (Continued) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
5	M9-1	Y	-18	47
6	M9-1	Y	-18	51
7	M9-2	Y	-18	1.01
8	M9-2	Y	-18	5.01

Member Point Loads (BLC 44 : P4-3A C174b Tor) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M8-1	Y	-14	2
2	M9-1	Y	-20	5
3	M9-1	Y	-20	9.5
4	M9-1	Y	-20	17.25
5	M9-1	Y	-20	21.75
6	M9-1	Y	-20	43.75
7	M9-1	Y	-20	48.25
8	M9-2	Y	-20	2.01
9	M9-2	Y	-20	6.51

Member Point Loads (BLC 45 : P4-3A C198 23 Tor) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M7-3	Y	-23	50.97
2	M7-4	Y	-23	.5
3	M8-1	Y	-23	6
4	M9-1	Y	-23	2.5
5	M9-1	Y	-23	28.5
6	M9-1	Y	-23	33
7	M9-1	Y	-23	46.5
8	M9-1	Y	-23	51
9	M9-3	Y	-14	1.01

Member Point Loads (BLC 46 : P4-3A C124b Tor) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M7-3	Y	-20	39.3
2	M7-3	Y	-20	43.8
3	M7-4	Y	-20	1.5
4	M7-4	Y	-20	6
5	M8-1	Y	-20	2.5
6	M9-1	Y	-20	23.5
7	M9-1	Y	-20	28
8	M9-1	Y	-20	32.5
9	M9-1	Y	-20	45.17
10	M9-1	Y	-20	49.67
11	M9-2	Y	-14	6.68

Member Point Loads (BLC 47 : P4-3A C237b Tor) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M9-3	Y	-13	0
2	M9-1	Y	-18.7	49.99
3	M9-1	Y	-18.7	45.49
4	M9-1	Y	-18.7	40.99
5	M9-1	Y	-18.7	26.99
6	M9-1	Y	-18.7	22.49
7	M9-1	Y	-18.7	17.99
8	M7-4	Y	-18.7	.49
9	M7-3	Y	-18.7	50.96
10	M7-3	Y	-18.7	46.46
11	M7-3	Y	-18.7	32.46

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Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

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Member Point Loads (BLC 47 : P4-3A C237b Tor) (Continued) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft. %]
12	M7-3	Y	-18.7	27.96
13	M7-3	Y	-18.7	23.46

Member Point Loads (BLC 48 : P4-3A C256b Tor) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft. %]
1	M9-2	Y	-16	6.15
2	M9-1	Y	-20	49.14
3	M9-1	Y	-20	44.14
4	M9-1	Y	-20	39.14
5	M9-1	Y	-20	23.47
6	M9-1	Y	-20	18.47
7	M9-1	Y	-20	13.47
8	M7-3	Y	-20	33.44
9	M7-3	Y	-20	28.44
10	M7-3	Y	-20	23.44
11	M7-3	Y	-20	7.77
12	M7-3	Y	-20	2.77
13	M7-2	Y	-20	7.77

Member Point Loads (BLC 49 : P4-3A C200j Tor) ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft. %]
1	M10-1	Y	-20	0
2	M9-2	Y	-20	0
3	M9-1	Y	-20	42.49
4	M9-1	Y	-20	32.99
5	M9-1	Y	-20	28.49
6	M9-1	Y	-20	23.99
7	M9-1	Y	-20	14.99
8	M9-1	Y	-20	4.49
9	M8-1	Y	-20	.49
10	M7-3	Y	-20	49.96

Member Distributed Loads (BLC 4 : P4-3A Lane Load) ✓

	Member Label	Direction	Start Magnitude[k/ft.d...]	End Magnitude[k/ft.d...]	Start Location[ft. %]	End Location[ft. %]
1	M8-1	Y	-.64	-.64	0	0
2	M9-1	Y	-.64	-.64	0	0
3	M9-2	Y	-.64	-.64	0	0
4	M10-1	Y	-.64	-.64	0	0
5	M10-2	Y	-.64	-.64	0	0
6	M10-4	Y	-.64	-.64	0	0
7	M9-3	Y	-.64	-.64	0	0
8	M10-3	Y	-.64	-.64	0	0
9	M10-5	Y	-.64	-.64	0	0
10	M10-6	Y	-.64	-.64	0	0
11	M12-1	Y	-.64	-.64	0	0
12	M12-2	Y	-.64	-.64	0	0
13	M12-3	Y	-.64	-.64	0	0
14	M12-4	Y	-.64	-.64	0	0
15	M6-4	Y	-.64	-.64	0	0
16	M6-3	Y	-.64	-.64	0	0
17	M6-2	Y	-.64	-.64	0	0
18	M6-1	Y	-.64	-.64	0	0
19	M3-5	Y	-.64	-.64	0	0
20	M3-4	Y	-.64	-.64	0	0
21	M3-3	Y	-.64	-.64	0	0

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Member Distributed Loads (BLC 4 : P4-3A Lane Load) (Continued) ✓

	Member Label	Direction	Start Magnitude[k/ft.d.]	End Magnitude[k/ft.d.]	Start Location[ft.%]	End Location[ft.%]
22	M3-2	Y	-64	-64	0	0
23	M3-1	Y	-64	-64	0	0
24	M1-3	Y	-64	-64	0	0
25	M1-2	Y	-64	-64	0	0
26	M1-1	Y	-64	-64	0	0

Member Distributed Loads (BLC 5 : P5-3A Lane Load) ✓

	Member Label	Direction	Start Magnitude[k/ft.d.]	End Magnitude[k/ft.d.]	Start Location[ft.%]	End Location[ft.%]
1	M7-3	Y	-64	-64	0	0
2	M7-1	Y	-64	-64	0	0
3	M7-2	Y	-64	-64	0	0
4	M7-4	Y	-64	-64	0	0
5	M8-1	Y	-64	-64	0	0
6	M9-1	Y	-64	-64	0	0
7	M9-2	Y	-64	-64	0	0
8	M9-3	Y	-64	-64	0	0
9	M11-1	Y	-64	-64	0	0
10	M11-2	Y	-64	-64	0	0
11	M11-3	Y	-64	-64	0	0
12	M11-4	Y	-64	-64	0	0
13	M11-5	Y	-64	-64	0	0
14	M13-1	Y	-64	-64	0	0
15	M14-1	Y	-64	-64	0	0
16	M5-1	Y	-64	-64	0	0
17	M4-3	Y	-64	-64	0	0
18	M4-2	Y	-64	-64	0	0
19	M4-1	Y	-64	-64	0	0
20	M2-6	Y	-64	-64	0	0
21	M2-5	Y	-64	-64	0	0
22	M2-4	Y	-64	-64	0	0
23	M2-3	Y	-64	-64	0	0
24	M2-2	Y	-64	-64	0	0
25	M2-1	Y	-64	-64	0	0

Member Distributed Loads (BLC 6 : P6-3A Lane Load) ✓

	Member Label	Direction	Start Magnitude[k/ft.d.]	End Magnitude[k/ft.d.]	Start Location[ft.%]	End Location[ft.%]
1	M7-3	Y	-64	-64	0	0
2	M7-4	Y	-64	-64	0	0
3	M7-2	Y	-64	-64	0	0
4	M7-1	Y	-64	-64	0	0
5	M6-4	Y	-64	-64	0	0
6	M6-3	Y	-64	-64	0	0
7	M6-2	Y	-64	-64	0	0
8	M6-1	Y	-64	-64	0	0
9	M3-5	Y	-64	-64	0	0
10	M3-4	Y	-64	-64	0	0
11	M3-3	Y	-64	-64	0	0
12	M3-2	Y	-64	-64	0	0
13	M3-1	Y	-64	-64	0	0
14	M1-3	Y	-64	-64	0	0
15	M1-2	Y	-64	-64	0	0
16	M1-1	Y	-64	-64	0	0
17	M10-1	Y	-64	-64	0	0
18	M10-2	Y	-64	-64	0	0
19	M10-3	Y	-64	-64	0	0
20	M10-4	Y	-64	-64	0	0
21	M10-5	Y	-64	-64	0	0

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Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 26, 2010
 11:36 AM
 Checked By: *GM*

5/510

Member Distributed Loads (BLC 6 : P6-3A Lane Load) (Continued) ✓

	Member Label	Direction	Start Magnitude[k/ft.d]	End Magnitude[k/ft.d]	Start Location[ft.%]	End Location[ft.%]
22	M10-6	Y	-64	-64	0	0
23	M12-1	Y	-64	-64	0	0
24	M12-2	Y	-64	-64	0	0
25	M12-3	Y	-64	-64	0	0
26	M12-4	Y	-64	-64	0	0

Member Distributed Loads (BLC 11 : P4-3A Lane Max Moment) ✓

	Member Label	Direction	Start Magnitude[k/ft.d]	End Magnitude[k/ft.d]	Start Location[ft.%]	End Location[ft.%]
1	M8-1	Y	-64	-64	0	0
2	M9-1	Y	-64	-64	0	0
3	M9-2	Y	-64	-64	0	0
4	M9-3	Y	-64	-64	0	0
5	M6-4	Y	-64	-64	0	0
6	M6-3	Y	-64	-64	0	0
7	M6-2	Y	-64	-64	0	0
8	M6-1	Y	-64	-64	0	0
9	M3-5	Y	-64	-64	0	0
10	M3-4	Y	-64	-64	0	0
11	M3-3	Y	-64	-64	0	0
12	M3-2	Y	-64	-64	0	0
13	M3-1	Y	-64	-64	0	0
14	M1-3	Y	-64	-64	0	0
15	M1-2	Y	-64	-64	0	0
16	M1-1	Y	-64	-64	0	0
17	M11-1	Y	-64	-64	0	0
18	M11-2	Y	-64	-64	0	0
19	M11-3	Y	-64	-64	0	0
20	M11-4	Y	-64	-64	0	0
21	M11-5	Y	-64	-64	0	0
22	M13-1	Y	-64	-64	0	0
23	M14-1	Y	-64	-64	0	0

Moving Loads ✓

	Tag	Pattern	Increme...	Both Ways	1st Joint	2nd J...	3rd J...	4th J...	5th J...	6th J...	7th J...	8th J...	9th J...	10th ...
1	M1	HS20-44-14FT	.25	Yes	P1-3C	P2-3A								
2	M2	TANDEM	.25	Yes	P1-3C	P2-3A								
3	M3	2TRUCKSAT50FT	.25	Yes	P1-3C	P2-3A								
4	M4	POST-TYPE3UNIT	1	Yes	P2-3C	P1-3A								
5	M5	POST-TYPE3S2-4...	1	Yes	P2-3C	P1-3A								
6	M6	POST-TYPE3S3U...	1	Yes	P2-3C	P1-3A								
7	M7	POST-SU4-TRUCK	1	Yes	P2-3C	P1-3A								
8	M8	POST-SU5-TRUCK	1	Yes	P2-3C	P1-3A								
9	M9	POST-SU6-TRUCK	1	Yes	P2-3C	P1-3A								
10	M10	POST-SU7-TRUCK	1	Yes	P2-3C	P1-3A								
11	M11	PERMIT-STD-A-TR...	1	Yes	P2-3C	P1-3A								
12	M12	PERMIT-STD-B-TR...	1	Yes	P2-3C	P1-3A								
13	M13	PERMIT-STD-C-TR...	1	Yes	P2-3C	P1-3A								
14	M14	PERMIT-P411-TRU...	1	Yes	P2-3C	P1-3A								
15	M15	PERMIT-P413-TRU...	1	Yes	P2-3C	P1-3A								
16	M16	PERMIT-STD-C152B	1	Yes	P2-3C	P1-3A								
17	M17	PERMIT-STD-C174B	1	Yes	P2-3C	P1-3A								
18	M18	PERMIT-STD-C198...	1	Yes	P2-3C	P1-3A								
19	M19	PERMIT-STD-C214B	1	Yes	P2-3C	P1-3A								
20	M20	PERMIT-STD-C237B	1	Yes	P2-3C	P1-3A								
21	M21	PERMIT-STD-C256B	1	Yes	P2-3C	P1-3A								
22	M22	PERMIT-STD-C200J	1	Yes	P2-3C	P1-3A								

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 26, 2010
 11:36 AM
 Checked By: *CJM*

5/6/10

Moving Loads (Continued) ✓

	Tag	Pattern	Increme...	Both Ways	1st Joint	2nd J...	3rd J...	4th J...	5th J...	6th J...	7th J...	8th J...	9th J...	10th ...
23	M23	PERMIT-STD-C152...	1	Yes	P2-3C	P1-3A								
24	M24	PERMIT-STD-C174...	1	Yes	P2-3C	P1-3A								
25	M25	PERMIT-STD-C198...	1	Yes	P2-3C	P1-3A								
26	M26	PERMIT-STD-C214...	1	Yes	P2-3C	P1-3A								
27	M27	PERMIT-STD-C237...	1	Yes	P2-3C	P1-3A								
28	M28	PERMIT-STD-C256...	1	Yes	P2-3C	P1-3A								

Moving Load Patterns ✓

Pattern Label	Load (k)	Direction	Distance (ft)
HS20-44-14FT	-8	V	0
	-32	V	14
	-32	V	14
TANDEM	-25	Y	0
	-25	Y	4
2TRUCKSAT50FT	-8	Y	0
	-32	Y	14
	-32	Y	14
	-8	Y	50
	-32	Y	14
	-32	Y	14
POST-TYPE3UNIT	-14	Y	0
	-17	Y	12
	-17	Y	4
POST-TYPE3S2-40UNIT	-12	Y	0
	-17	Y	15
	-17	Y	4
	-17	Y	28
	-17	Y	4
POST-TYPE3S3UNIT	-9	Y	0
	-16	Y	10
	-16	Y	4
	-13	Y	25
	-13	Y	4
	-13	Y	4
POST-SU4-TRUCK	-12	Y	0
	-8	Y	10
	-17	Y	4
	-17	Y	4
POST-SU5-TRUCK	-12	Y	0
	-8	Y	10
	-8	Y	4
	-17	Y	4
	-17	Y	4

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 26, 2010
 11:36 AM
 Checked By: *jam*

Moving Load Patterns ✓

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Pattern Label	Load (k)	Direction	Distance (ft)
POST-SU6-TRUCK	-11.5	Y	0
	-8	Y	10
	-8	Y	4
	-17	Y	4
	-17	Y	4
	-8	Y	4

POST-SU7-TRUCK	-11.5	Y	0
	-8	Y	10
	-8	Y	4
	-17	Y	4
	-17	Y	4
	-8	Y	4
	-8	Y	4

PERMIT-STD-A-TRUCK	-8	Y	0
	-16	Y	12
	-16	Y	4
	-16	Y	4
	-16	Y	18
	-16	Y	4
	-16	Y	4

PERMIT-STD-B-TRUCK	-16	Y	0
	-20	Y	10
	-20	Y	4
	-20	Y	4
	-20	Y	23
	-20	Y	4
	-20	Y	4

PERMIT-STD-C-TRUCK	-15	Y	0
	-18	Y	10
	-18	Y	4
	-18	Y	4
	-18	Y	4
	-18	Y	23
	-18	Y	4
	-18	Y	4

PERMIT-P411-TRUCK	-15	Y	0
	-19.2	Y	10
	-19.2	Y	4
	-19.2	Y	4
	-19.2	Y	12
	-19.2	Y	4
	-19.2	Y	35
	-19.2	Y	4
	-19.2	Y	12
	-19.2	Y	4
	-19.2	Y	4

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 26, 2010
 11:36 AM
 Checked By: *CSM*

Moving Load Patterns ✓

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Pattern Label	Load (k)	Direction	Distance (ft)
PERMIT-P413-TRUCK	-15	Y	0
	-20	Y	10
	-20	Y	4
	-20	Y	4
	-20	Y	20
	-20	Y	4
	-20	Y	4
	-20	Y	35
	-20	Y	4
	-20	Y	4
	-20	Y	20
	-20	Y	4
	-20	Y	4

PERMIT-STD-C152B	-16	Y	0
	-21.4	Y	9.5
	-21.4	Y	4
	-21.4	Y	4
	-18	Y	23.5
	-18	Y	4
	-18	Y	4
	-18	Y	4

PERMIT-STD-C174B	-14	Y	0
	-20	Y	11
	-20	Y	4.5
	-20	Y	7.75
	-20	Y	4.5
	-20	Y	22
	-20	Y	4.5
	-20	Y	7.75
	-20	Y	4.5

PERMIT-STD-C198 23	-14	Y	0
	-23	Y	11
	-23	Y	4.5
	-23	Y	13.5
	-23	Y	4.5
	-23	Y	26
	-23	Y	4.5
	-23	Y	13.5
	-23	Y	4.5

PERMIT-STD-C214B	-14	Y	0
	-20	Y	11
	-20	Y	4.5
	-20	Y	12.67
	-20	Y	4.5
	-20	Y	4.5
	-20	Y	29
	-20	Y	4.5
	-20	Y	4.5
	-20	Y	12.67
	-20	Y	4.5

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Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 26, 2010
 11:36 AM
 Checked By: CJM

Moving Load Patterns ✓

5/6/10

Pattern Label	Load (k)	Direction	Distance (ft)
PERMIT-STD-C237B	-13	Y	0
	-18.7	Y	11
	-18.7	Y	4.5
	-18.7	Y	4.5
	-18.7	Y	14
	-18.7	Y	4.5
	-18.7	Y	4.5
	-18.7	Y	33.5
	-18.7	Y	4.5
	-18.7	Y	4.5
	-18.7	Y	14
	-18.7	Y	4.5
	-18.7	Y	4.5

PERMIT-STD-C256B	-16	Y	0
	-20	Y	11
	-20	Y	5
	-20	Y	5
	-20	Y	15.67
	-20	Y	5
	-20	Y	5
	-20	Y	36
	-20	Y	5
	-20	Y	5
	-20	Y	15.67
	-20	Y	5
	-20	Y	5

PERMIT-STD-C200J	-20	Y	0
	-20	Y	13.5
	-20	Y	12
	-20	Y	10.5
	-20	Y	9
	-20	Y	4.5
	-20	Y	4.5
	-20	Y	9.5
	-20	Y	11.5
	-20	Y	13

PERMIT-STD-C152B-LONG	-16	Y	0
	-21.4	Y	9.5
	-21.4	Y	4
	-21.4	Y	4
	-18	Y	33.5
	-18	Y	4
	-18	Y	4
	-18	Y	4

PERMIT-STD-C174B-LONG	-14	Y	0
	-20	Y	11
	-20	Y	4.5
	-20	Y	7.75
	-20	Y	4.5
	-20	Y	32
	-20	Y	4.5
	-20	Y	7.75
	-20	Y	4.5

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 26, 2010
 11:36 AM
 Checked By: CJM

Moving Load Patterns ✓

5/6/10

Pattern Label	Load (k)	Direction	Distance (ft)
PERMIT-STD-C198_23-LONG	-14	Y	0
	-23	Y	11
	-23	Y	4.5
	-23	Y	13.5
	-23	Y	4.5
	-23	Y	36
	-23	Y	4.5
	-23	Y	13.5
	-23	Y	4.5

PERMIT-STD-C214B-LONG	-14	Y	0
	-20	Y	11
	-20	Y	4.5
	-20	Y	12.67
	-20	Y	4.5
	-20	Y	4.5
	-20	Y	39
	-20	Y	4.5
	-20	Y	4.5
	-20	Y	12.67
	-20	Y	4.5

PERMIT-STD-C237B-LONG	-13	Y	0
	-18.7	Y	11
	-18.7	Y	4.5
	-18.7	Y	4.5
	-18.7	Y	14
	-18.7	Y	4.5
	-18.7	Y	4.5
	-18.7	Y	48.5
	-18.7	Y	4.5
	-18.7	Y	4.5
	-18.7	Y	14
	-18.7	Y	4.5
	-18.7	Y	4.5

PERMIT-STD-C256B-LONG	-16	Y	0
	-20	Y	11
	-20	Y	5
	-20	Y	5
	-20	Y	15.67
	-20	Y	5
	-20	Y	5
	-20	Y	51
	-20	Y	5
	-20	Y	5
	-20	Y	15.67
	-20	Y	5
	-20	Y	5

Basic Load Cases ✓

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distributed	Area (Me...	Surface (...)
1	P4-3A Reaction Influe...	None				1				
2	P5-3A Reaction Influe...	None				1				
3	P6-3A Reaction Influe...	None				1				

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Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 26, 2010
 11:36 AM
 Checked By: *CTM*

Basic Load Cases (Continued) ✓

5/10/10

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distributed Area (Me...	Surface (...)
4	P4-3A Lane Load	None						26	
5	P5-3A Lane Load	None						25	
6	P6-3A Lane Load	None						26	
7	P4-3A 2 Truck at 50 ft	None					6		
8	Horizontal Load	None				2			
9	P4-3A Truck Max Re...	None					3		
10	P4-3A Truck Max Mo...	None					3		
11	P4-3A Lane Max Mo...	None						23	
12	P4-3A Type 3 Reac	None					3		
13	P4-3A Type 3S2-40 R...	None					5		
14	P4-3A Type 3S3 Reac	None					6		
15	P4-3A SU4 Reac	None							
16	P4-3A SU5 Reac	None							
17	P4-3A SU6 Reac	None							
18	P4-3A SU7 Reac	None					7		
19	P4-3A Std A Reac	None					7		
20	P4-3A Std B Reac	None					7		
21	P4-3A Std C Reac	None					9		
22	P4-3A P411 Reac	None					11		
23	P4-3A P413 Reac	None					13		
24	P4-3A C152b Reac	None					8		
25	P4-3A C174b Reac	None					9		
26	P4-3A C198_23 Reac	None					9		
27	P4-3A C214b Reac	None					11		
28	P4-3A C237b Reac	None					13		
29	P4-3A C256b Reac	None					13		
30	P4-3A C200j Reac	None					10		
31	P4-3A Type 3 Tor	None					3		
32	P4-3A Type 3S2-40 T...	None					5		
33	P4-3A Type 3S3 Tor	None					6		
34	P4-3A SU4 Tor	None							
35	P4-3A SU5 Tor	None							
36	P4-3A SU6 Tor	None							
37	P4-3A SU7 Tor	None					7		
38	P4-3A Std A Tor	None					7		
39	P4-3A Std B Tor	None					7		
40	P4-3A Std C Tor	None					9		
41	P4-3A P411 Tor	None					11		
42	P4-3A P413 Tor	None					13		
43	P4-3A C152b Tor	None					8		
44	P4-3A C174b Tor	None					9		
45	P4-3A C198_23 Tor	None					9		
46	P4-3A C124b Tor	None					11		
47	P4-3A C237b Tor	None					13		
48	P4-3A C256b Tor	None					13		
49	P4-3A C200j Tor	None					10		

Load Combinations ✓

	Description	Sol...	PD...	SR...	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor
1	P4-3A Influence				1	1													
2	P5-3A Influence				2	1													
3	P6-3A Influence				3	1													
4	P4 Lane Load				4	1													
5	P5 Lane Load				5	1													
6	P6 Lane Load				6	1													
7	Moving Truck				M1	1													

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

5/6/0

[illegible]

I-62

Company : LHB
Designer : jdf
Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 26, 2010
11:36 AM
Checked By: cm

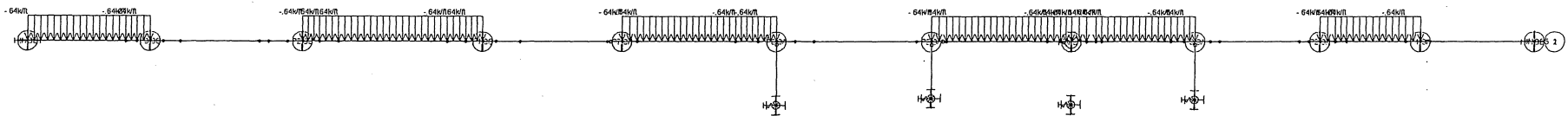
5/6/10

Load Combinations (Continued) ✓

	Description	Sol...	PD...	SR...	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor
65	P4-3A C152b Tor	Yes			43	1													
66	P4-3A C174b Tor	Yes			44	1													
67	P4-3A C198 23 Tor	Yes			45	1													
68	P4-3A C124b Tor	Yes			46	1													
69	P4-3A C237b Tor	Yes			47	1													
70	P4-3A C256b Tor	Yes			48	1													
71	P4-3A C200i Tor	Yes			49	1													
72	PERMIT-STD-C152B-LO...				M23	1													
73	PERMIT-STD-C174B-LO...				M24	1													
74	PERMIT-STD-C198_23-L...				M25	1													
75	PERMIT-STD-C214B-LO...				M26	1													
76	PERMIT-STD-C237B-LO...				M27	1													
77	PERMIT-STD-C256B-LO...				M28	1													

I-63

Y
Lx



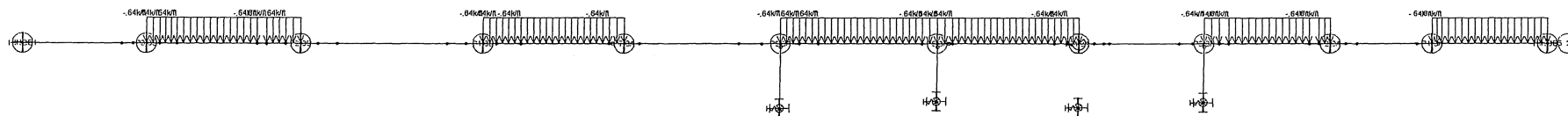
VC5M 3/5/10

Loads: BLC 4, P4-3A Lane Load

LHB	Pier 4,5,6-3A, Girder A and Beam A, Live Loads	
jdf		Mar 9, 2010 at 9:30 AM
090147		090147_3A_P456_GirderABeamA.r3d

I-64

EL



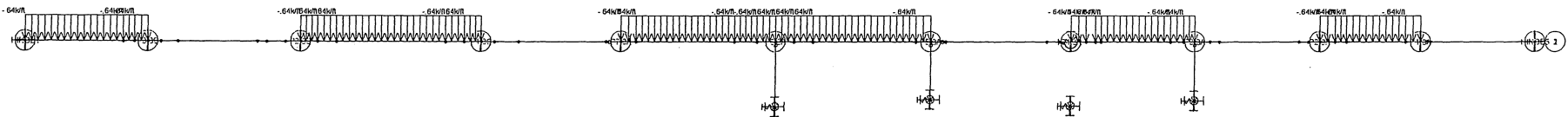
✓CSM
5/5/10

Load: BLC 5, P5-3A Lane Load

LHB	Pier 4,5,6-3A, Girder A and Beam A, Live Loads	
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090147		090147_3A_P456_GirderABeamA.r3d

165

ELx



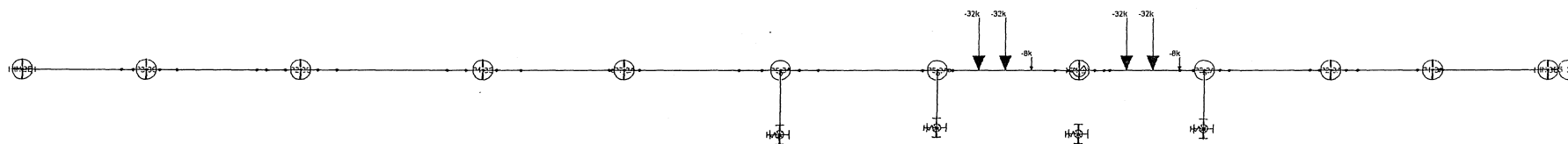
LCM
5/5/10

Loads: BLC 6, PB-3A Lane Load

LHB	Pier 4,5,6-3A, Girder A and Beam A, Live Loads	
jdf		Mar 9, 2010 at 9:30 AM
090147		090147_3A_P456_GirderABeamA.r3d

9/6

Y
Lx



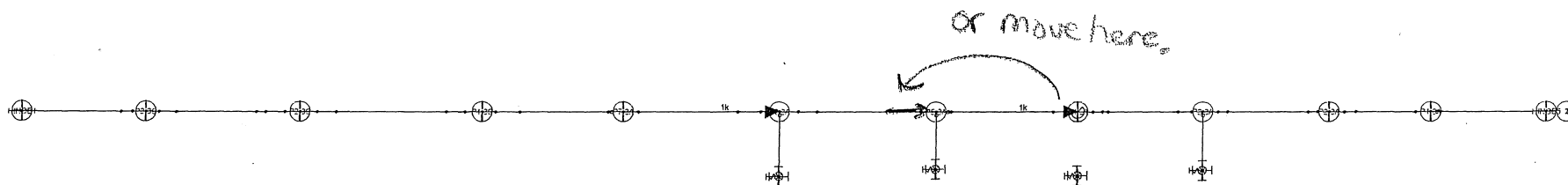
✓
5/12/10
WCS

Loads: BLC 7, P4-3A 2 Truck at 50 ft

LHB	Pier 4,5,6-3A, Girder A and Beam A, Live Loads	
jdf		Mar 9, 2010 at 9:31 AM
090147		090147_3A_P456_GirderABeamA.r3d

7-62

Y
Lx



cam
static

Loads, BLC 8, Horizontal Load

LHB
jdf
090147

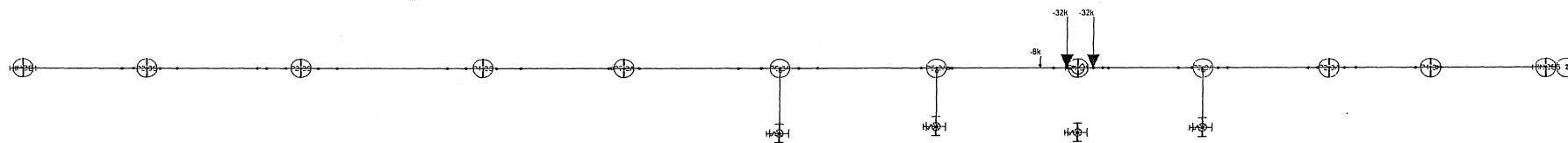
Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Mar 9, 2010 at 9:31 AM

090147_3A_P456_GirderABeamA.r3d

89-1
68

Y
L_x



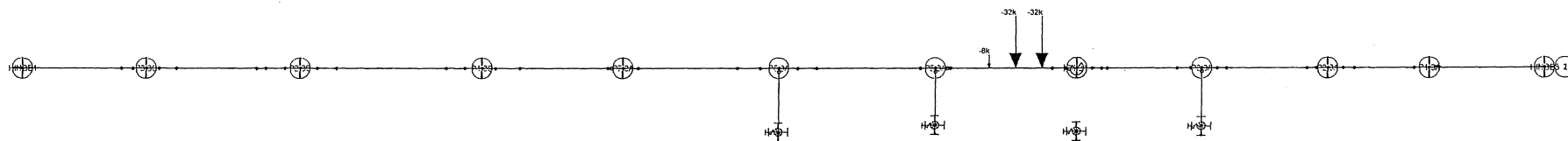
vcsm
s/12/10

Loads: BLC B, P4-3A Truck Max Reaction

LHB	Pier 4,5,6-3A, Girder A and Beam A, Live Loads	
jdf		Mar 9, 2010 at 9:31 AM
090147		090147_3A_P456_GirderABeamA.r3d

T-169

Y
Z L X



VCTM
5/12/10

Loads: BLC 10, P4-3A Truck Max Moment

LHB

jdf

090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

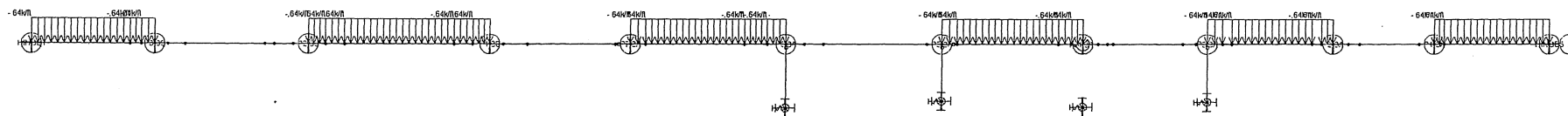
Mar 9, 2010 at 9:31 AM

090147_3A_P456_GirderABeamA.r3d

07-1

17-1

Y
Lx



103m
5/5/10

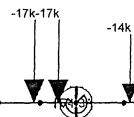
Loads: BLC 11, P4-3A Lane Max Moment

LHB
jdf
090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Mar 9, 2010 at 9:31 AM

090147_3A_P456_GirderABeamA.r3d



1/25/10
5/12/10

Loads: BLC 12, P4-3A Type 3 Reac

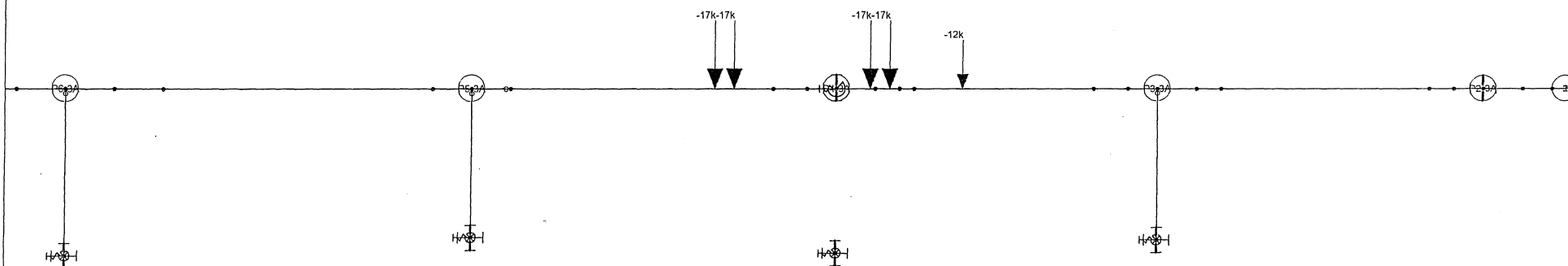
LHB
jdf
090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:05 AM

090147_3A_P456_GirderABeamA.r3d

27-72



1/5/10
5/12/10

Loads: BLC 13, P4-3A Type 3S2-40 Reac

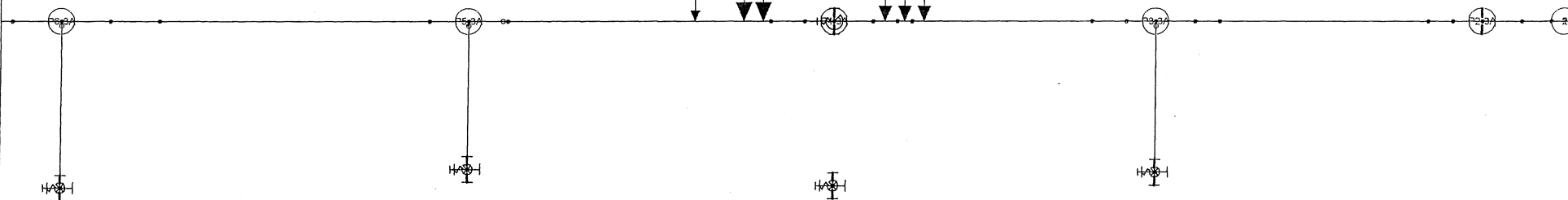
LHB
jdf
090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:08 AM

090147_3A_P456_GirderABeamA.r3d

1-43



WCSM
5/12/10

Loads: BLC 14, P4-3A Type 3S3 Reac

LHB
jdf
090147

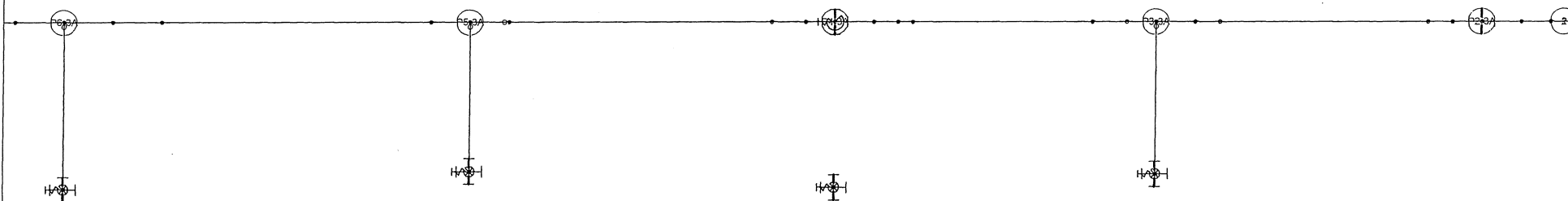
Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:09 AM

090147_3A_P456_GirderABeamA.r3d



will not control
(placeholder only)



✓
5/12/10

Loads: BLC 15, P4-3A SU4 Reac

LHB

jdf

090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

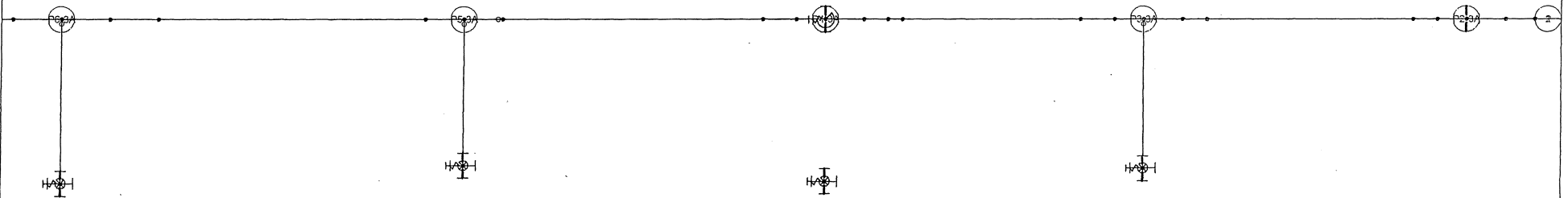
Apr 19, 2010 at 11:09 AM

090147_3A_P456_GirderABeamA.r3d

5/12/10



will not control
(placeholder only)



✓
scm
5/12/10

Loads: BLC 16, P4-3A SU5 Reac

LHB

jdf

090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

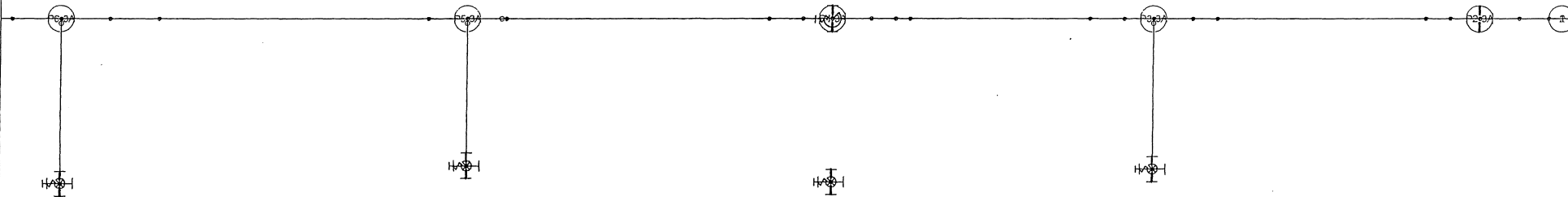
Apr 19, 2010 at 11:09 AM

090147_3A_P456_GirderABeamA.r3d

I-76



will not control
(place holder only)



1/27/10
5/12/10
VSM

Loads: BLC 17, P4-3A SU8 Reac

LHB

jdf

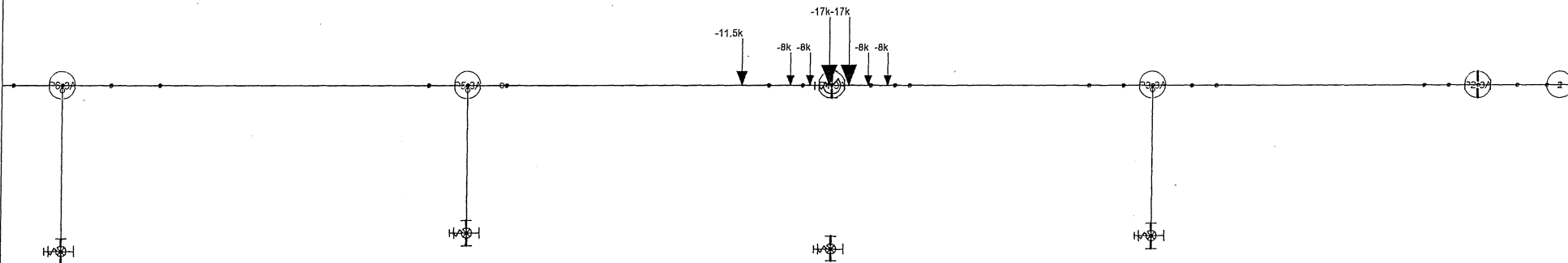
090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:09 AM

090147_3A_P456_GirderABeamA.r3d

17-1



Loads: BLC 18, P4-3A SU7 Reac

LHB
jdf
090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

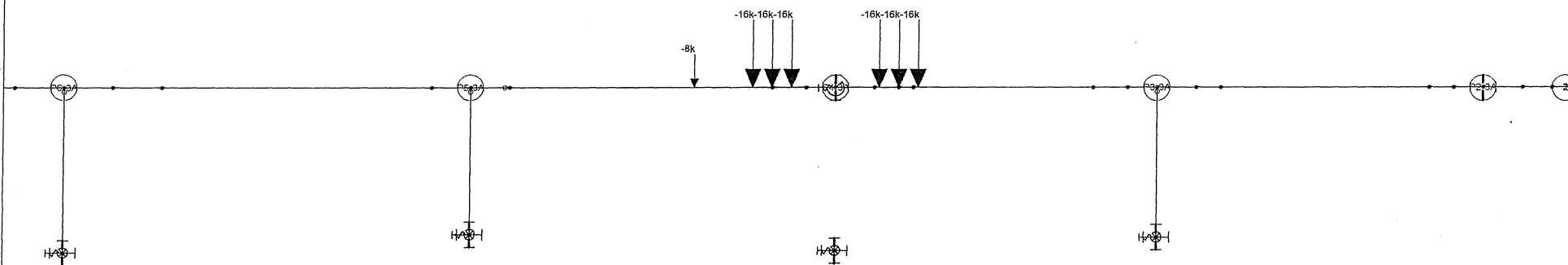
Apr 19, 2010 at 11:09 AM

090147_3A_P456_GirderABeamA.r3d

VCJM
5/12/10

84-7

Y
Z X



VC5M
5/12/10

Loads: BLC 19, P4-3A Std A Reac

LHB
jdf
090147

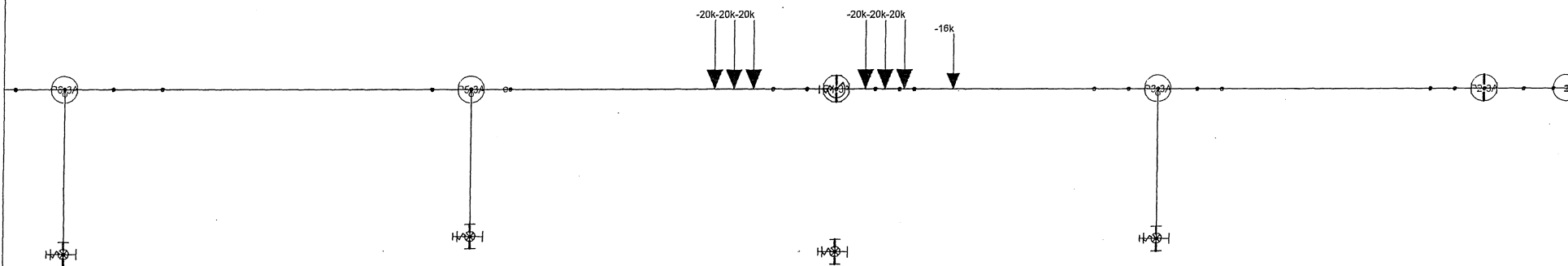
Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:09 AM

090147_3A_P456_GirderABeamA.r3d

64-1

Y
Z
X



Loads: BLC 20, P4-3A Std B Reac

LHB

jdf

090147

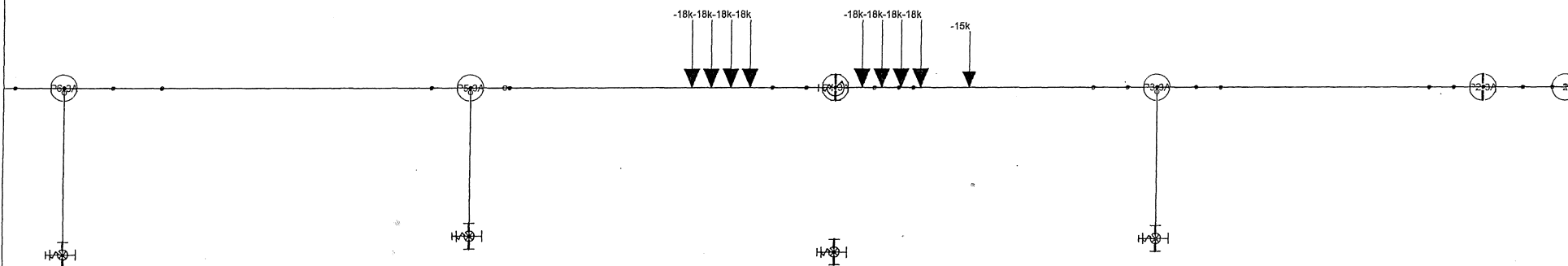
Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:09 AM

090147_3A_P456_GirderABeamA.r3d

UCSW
5/12/10

08-I



Loads: BLC 21, P4-3A Std C Reac

LHB
jdf
090147

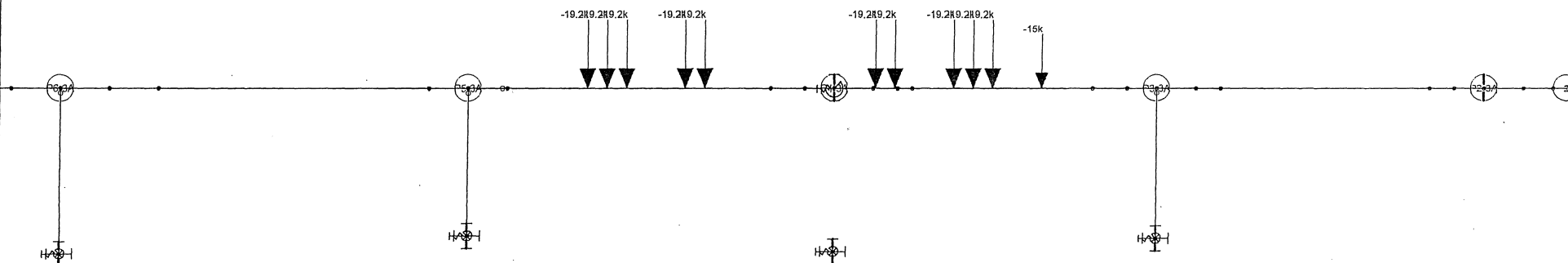
Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:09 AM

090147_3A_P456_GirderABeamA.r3d

1/63M
5/12/10
01/21/10

Y
Z
X



Loads: BLC 22, P4-3A P411 Reac

LHB
jdf
090147

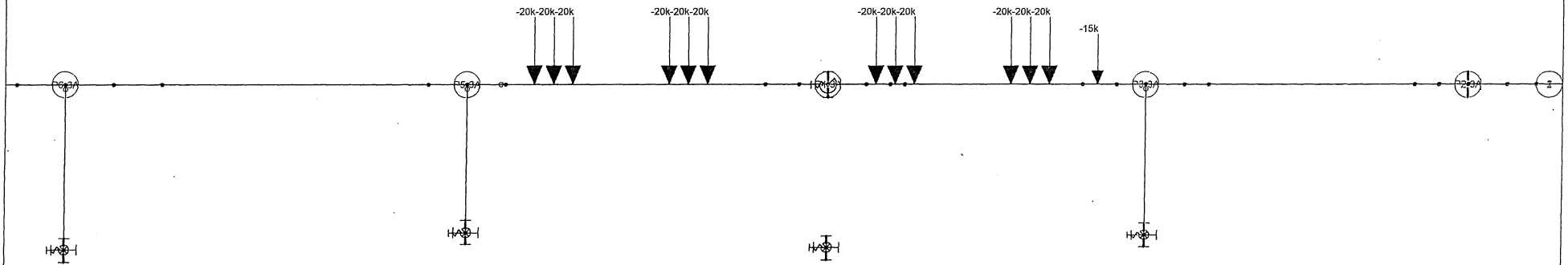
Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:09 AM

090147_3A_P456_GirderABeamA.r3d

5/12/10
VCSM

22-82



Loads: BLC 23, P4-3A P413 Reac

LHB

jdf

090147

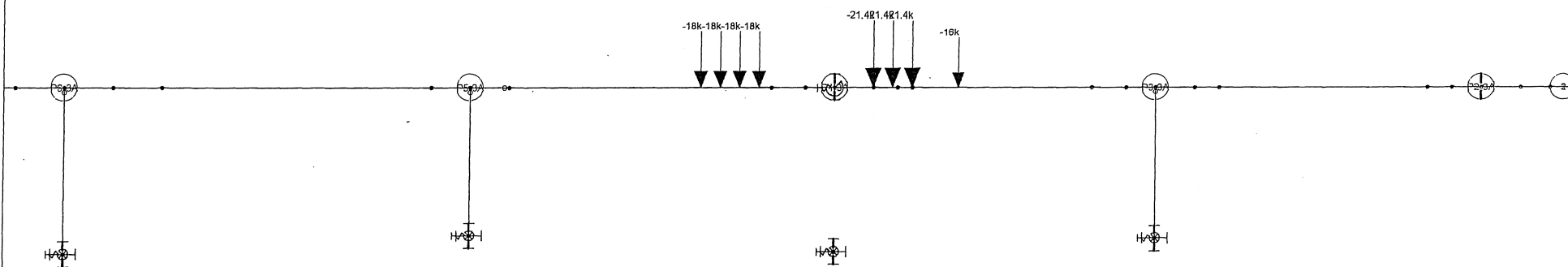
Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:09 AM

090147_3A_P456_GirderABeamA.r3d

✓CSM
5/12/10

I-83



Loads: BLC 24, P4-3A C152b Reac

LHB

jdf

090147

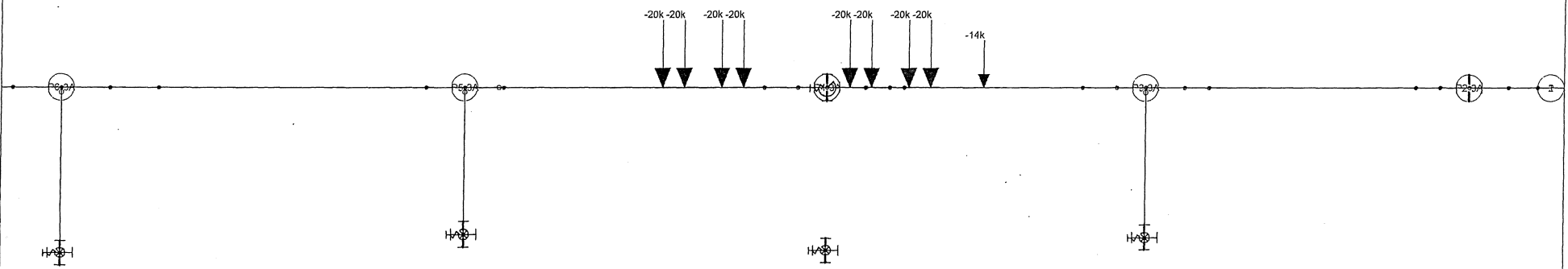
Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:10 AM

090147_3A_P456_GirderABeamA.r3d

✓
5/12/10

78-1



1/21/10
5/12/10
VSTW

Loads: BLC 25, P4-3A C174b Reac

LHB
jdf
090147

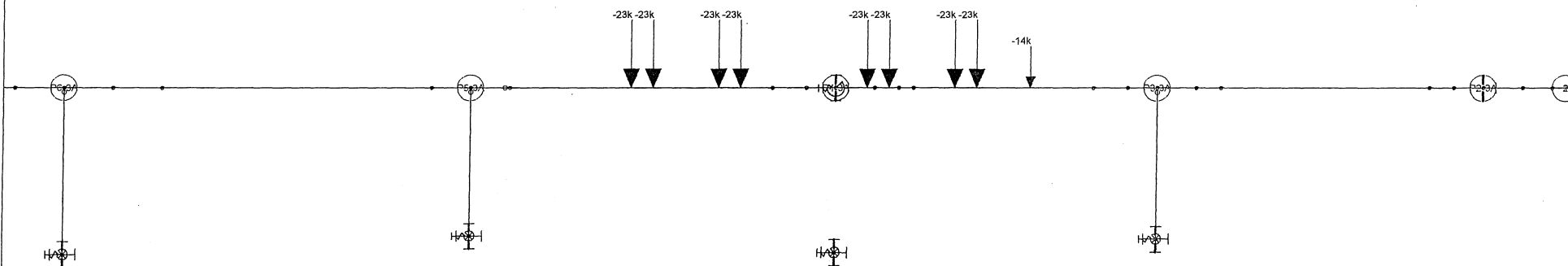
Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:10 AM

090147_3A_P456_GirderABeamA.r3d

58-7

Y
Z Lx



Loads: BLC 26, P4-3A C198_23 Reac

LHB
jdf
090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

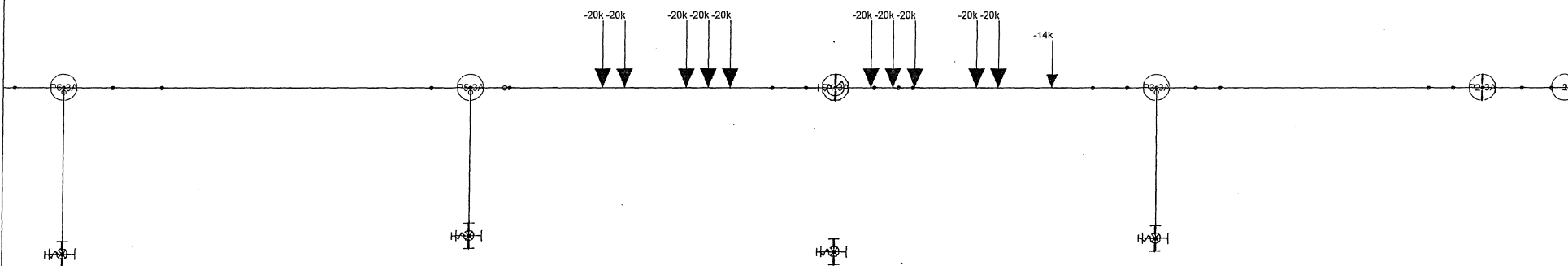
Apr 19, 2010 at 11:10 AM

090147_3A_P456_GirderABeamA.r3d

1/5/10
step

98-1

Y
Z L X



Loads: BLC 27, P4-3A C214b Reac

LHB

jdf

090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:10 AM

090147_3A_P456_GirderABeamA.r3d

1/6/10
S/12/10



Loads: BLC 28, P4-3A C237b Reac

LHB

jdf

090147

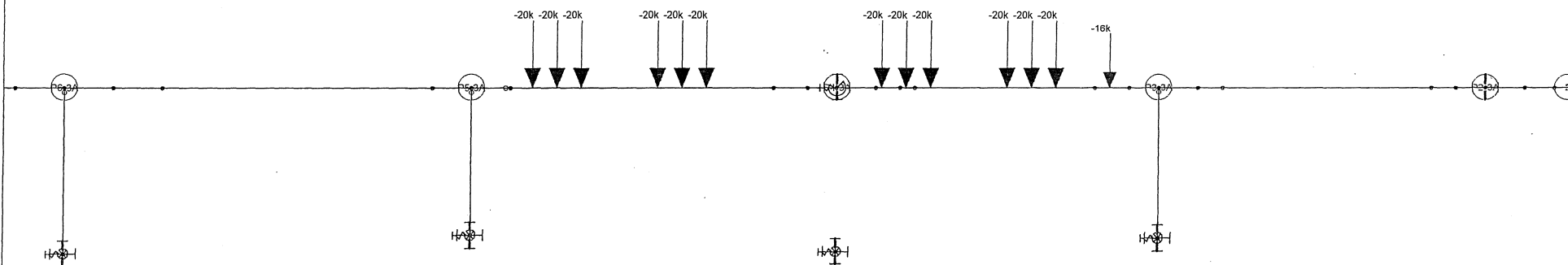
Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:10 AM

090147_3A_P456_GirderABeamA.r3d

UOTM
Studio

Y
Z
X



Loads: BLC 29, P4-3A C256b Reac

LHB

jdf

090147

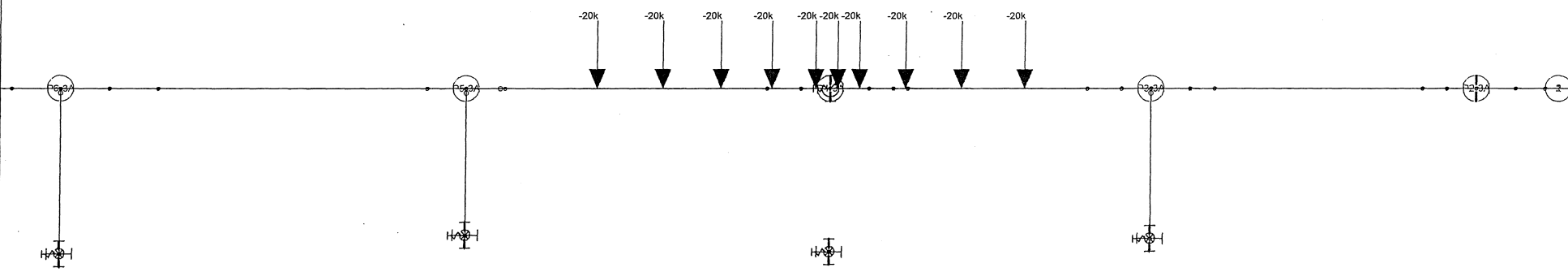
Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:10 AM

090147_3A_P456_GirderABeamA.r3d

UCSW
5/12/10

18-1



VC 5M
5/12/10

Loads: BLC 30, P4-3A C200J Reac

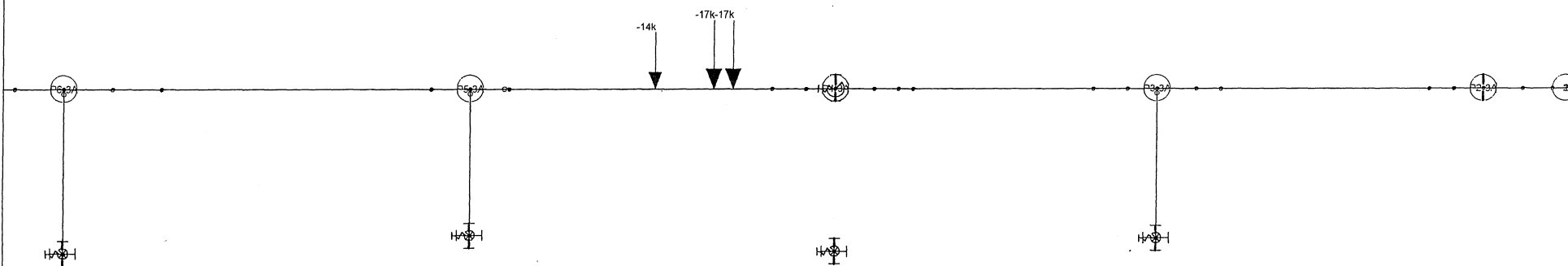
LHB
jdf
090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:10 AM

090147_3A_P456_GirderABeamA.r3d

06-1-90



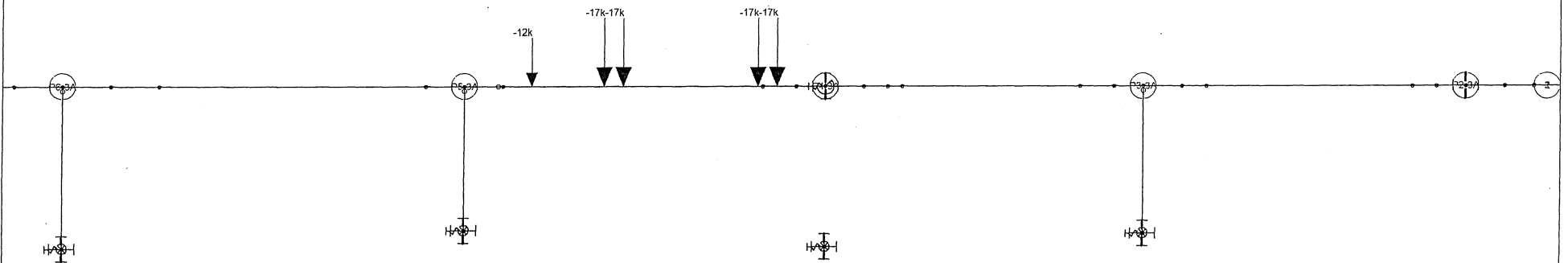
Loads: BLC 31, P4-3A Type 3 Tor

LHB
jdf
090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:10 AM
090147_3A_P456_GirderABeamA.r3d

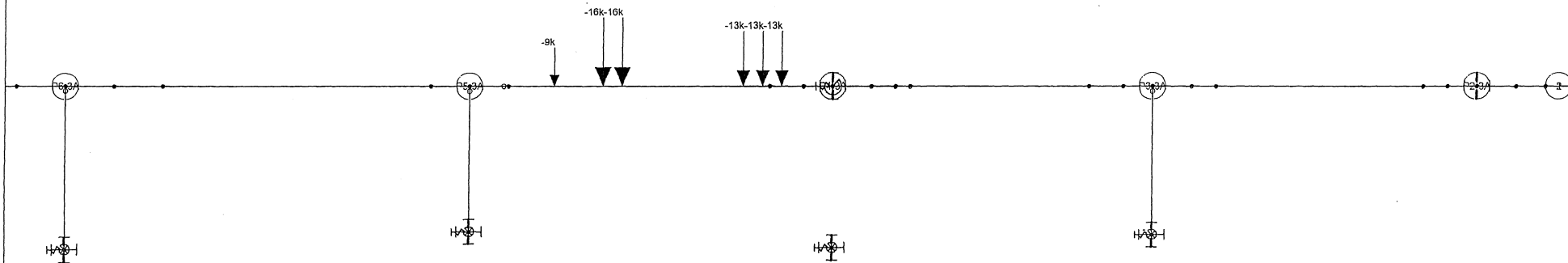
16-1
CWD
0.000



Loads: BLC 32, P4-3A Type 3S2-40 Tor

LHB	Pier 4,5,6-3A, Girder A and Beam A, Live Loads	
jdf		Apr 19, 2010 at 11:10 AM
090147		090147_3A_P456_GirderABeamA.r3d

1/6/10
5/12/10



Loads: BLC 33, P4-3A Type 3S3 Tor

LHB

jdf

090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

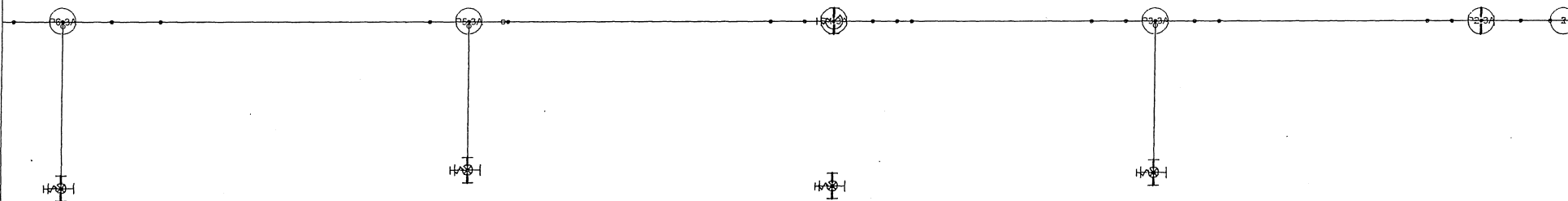
Apr 19, 2010 at 11:10 AM

090147_3A_P456_GirderABeamA.r3d

vcsm
5/12/10

Y
Z X

will not control
(place holder only)



beam
5/12/10

Loads: BLC 34, P4-3A SU4 Tor

LHB
jdf
090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

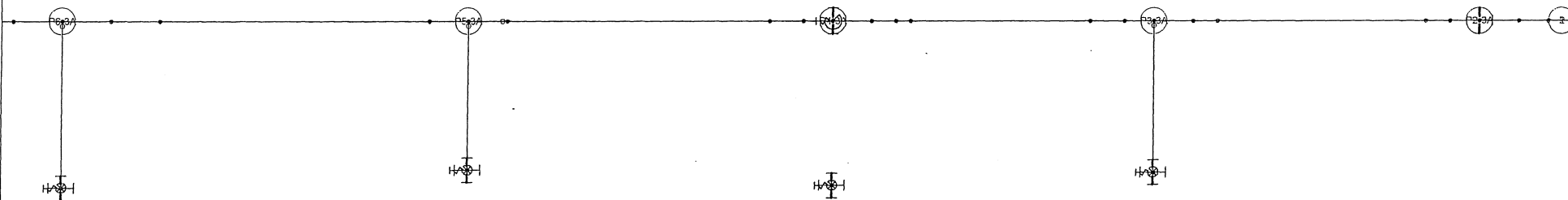
Apr 19, 2010 at 11:11 AM

090147_3A_P456_GirderABeamA.r3d

46-1

Y
Z X

will not control.
(place holder only)



Actua
5/12/10

Loads: BLC 35, P4-3A SU5 Tor

LHB

jdf

090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

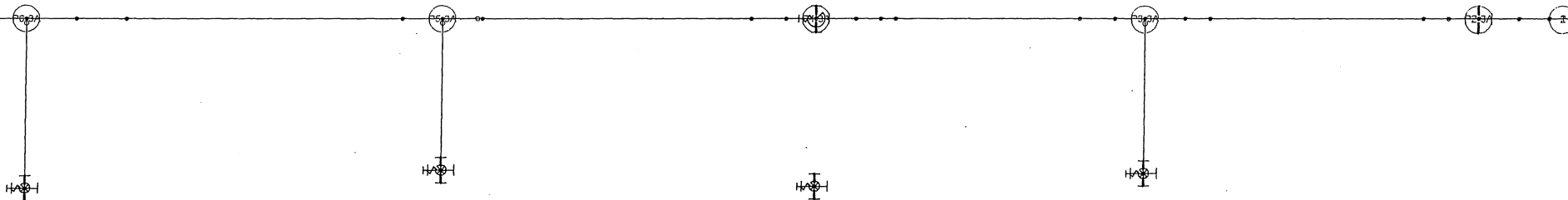
Apr 19, 2010 at 11:11 AM

090147_3A_P456_GirderABeamA.r3d

7-95



will not control
(place holder only)



10544
5/12/10

Loads: BLC 36, P4-3A SU6 Tor

LHB

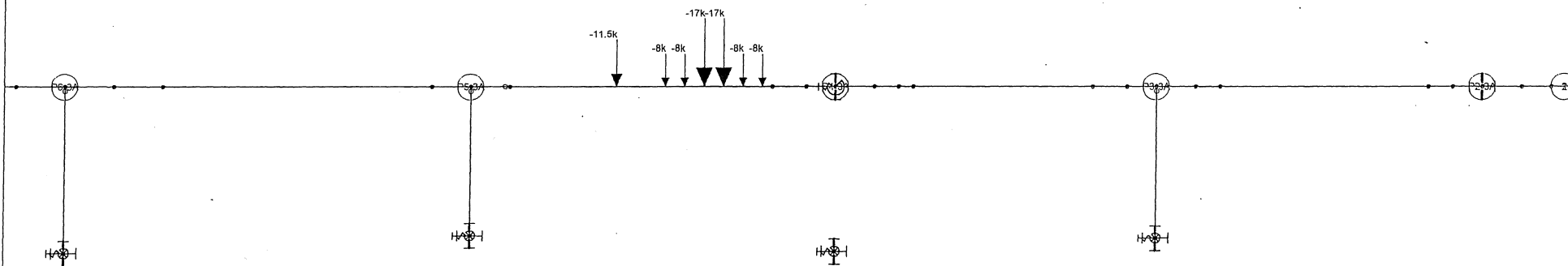
jdf

090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:11 AM

090147_3A_P456_GirderABeamA.r3d

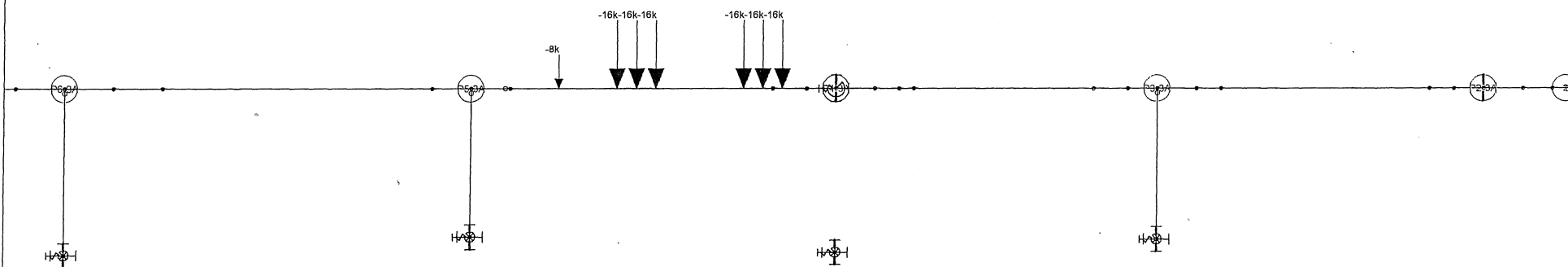


105M
5/12/10

Loads: BLC 37, P4-3A SU7 Tor

LHB	Pier 4,5,6-3A, Girder A and Beam A, Live Loads	
jdf		Apr 19, 2010 at 11:11 AM
090147		090147_3A_P456_GirderABeamA.r3d

Y
L₂
L_x



Loads: BLC 38, P4-3A Std A Tor

LHB

jdf

090147

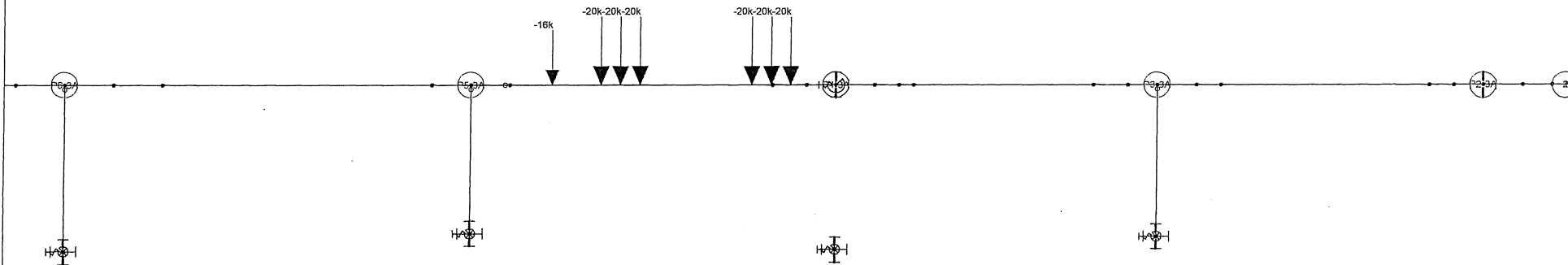
Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:11 AM

090147_3A_P456_GirderABeamA.r3d

6.5M
5/12/10

86-1



Uctm
5/12/10

Loads: BLC 39, P4-3A Std B Tor

LHB

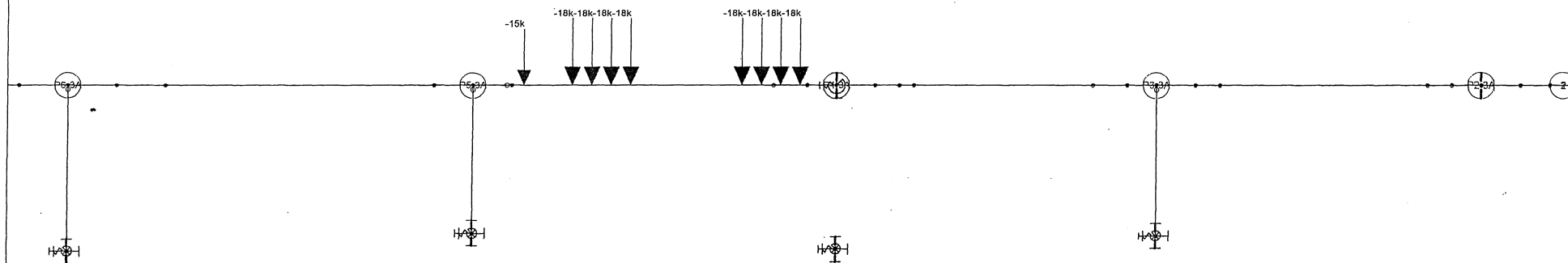
jdf

090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:11 AM

090147_3A_P456_GirderABeamA.r3d



✓CSM
5/12/10

Loads: BLC 40, P4-3A Std C Tor

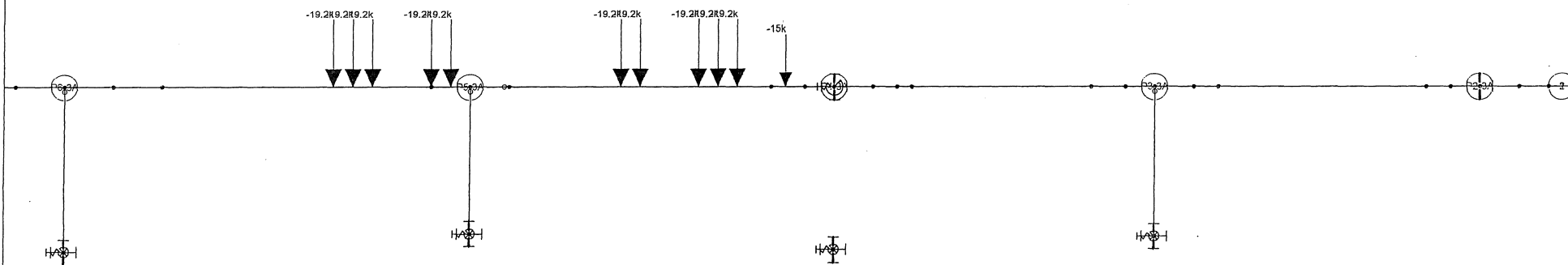
LHB
jdf
090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:11 AM

090147_3A_P456_GirderABeamA.r3d

Y
Z
X



Loads: BLC 41, P4-3A P411 Tor

LHB

jdf

090147

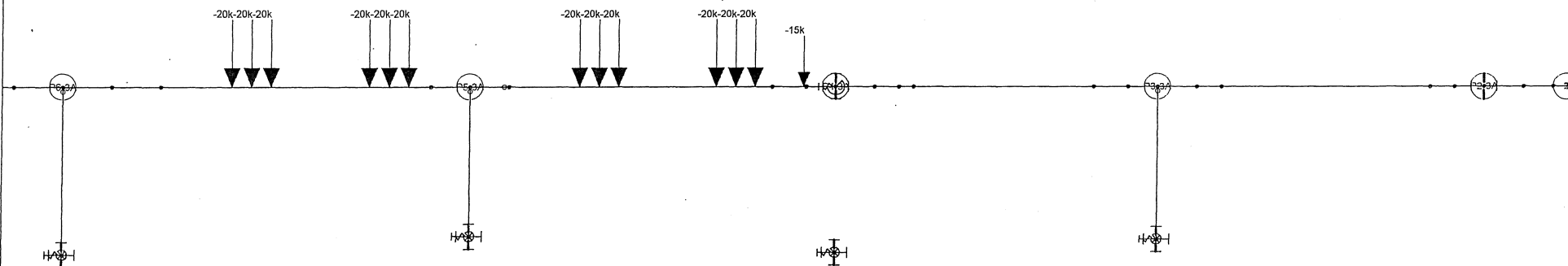
Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:11 AM

090147_3A_P456_GirderABeamA.r3d

101-L
VCSM
5/12/10

Y
Z L X



1/25/10
S12/10

Loads: BLC 42, P4-3A P413 Tor

LHB

jdf

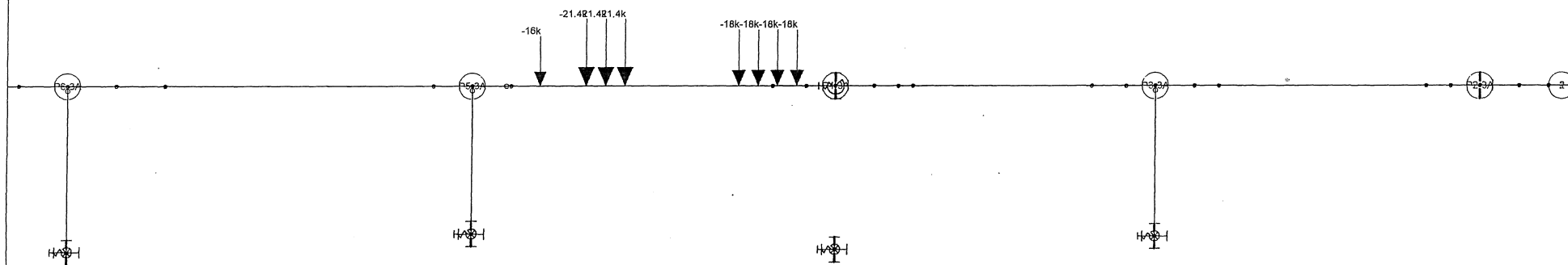
090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:12 AM

090147_3A_P456_GirderABeamA.r3d

I-102



Loads: BLC 43, P4-3A C152b Tor

LHB

jdf

090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

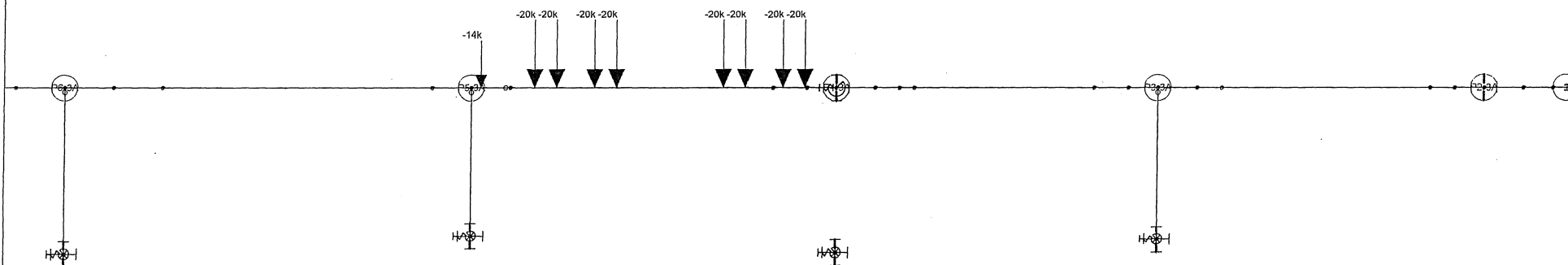
Apr 19, 2010 at 11:12 AM

090147_3A_P456_GirderABeamA.r3d

✓CSM
5/12/10

I-103

Y
Z X



Loads: BLC 44, P4-3A C174b Tor

LHB
jdf
090147

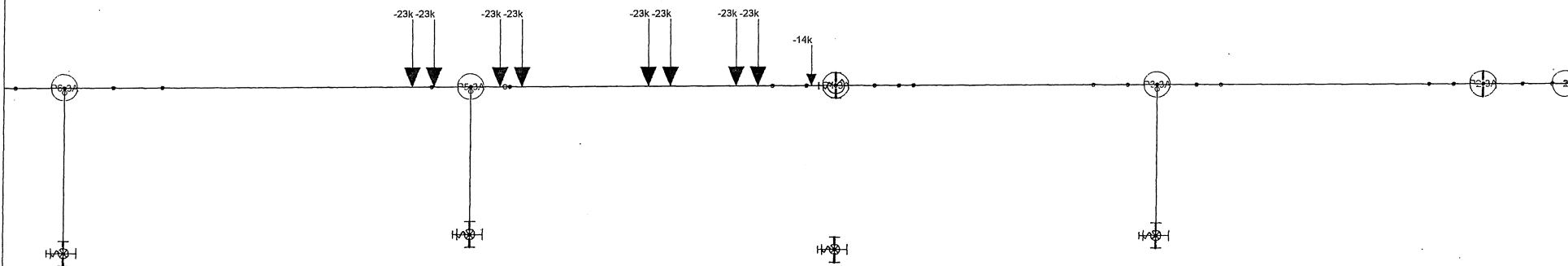
Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:12 AM

090147_3A_P456_GirderABeamA.r3d

1054
5/12/10

401-1



✓CSM
5/12/10

Loads: BLC 45, P4-3A C198_23 Tor

LHB

jdf

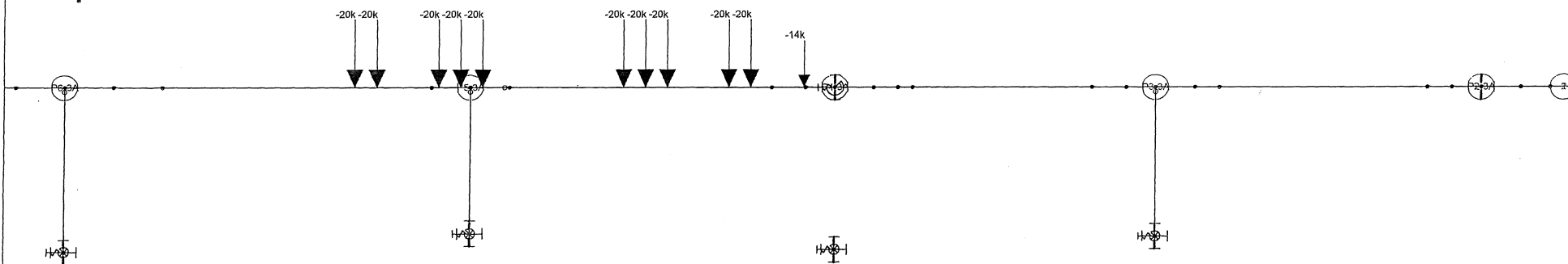
090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:12 AM

090147_3A_P456_GirderABeamA.r3d

501-105



Loads: BLC 46, P4-3A C124b Tor

LHB

jdf

090147

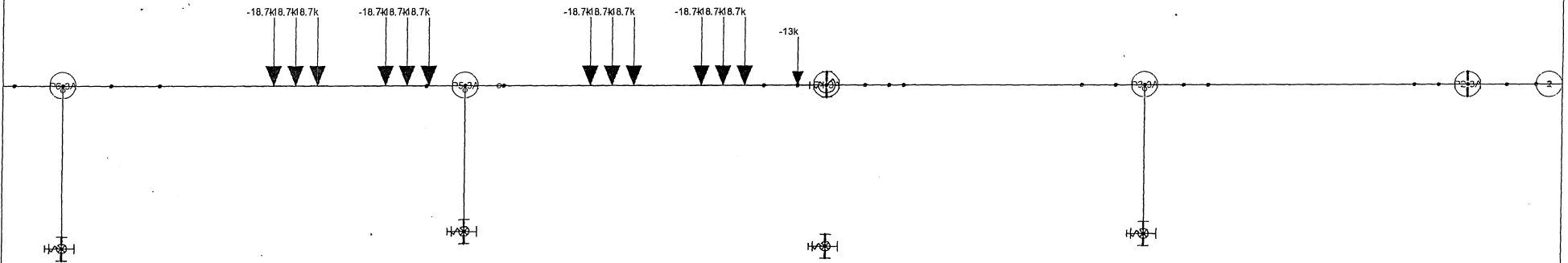
Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:12 AM

090147_3A_P456_GirderABeamA.r3d

vcsm
5/12/10

901-106



✓
CSM
5/12/10

Loads: BLC 47, P4-3A C237b Tor

LHB

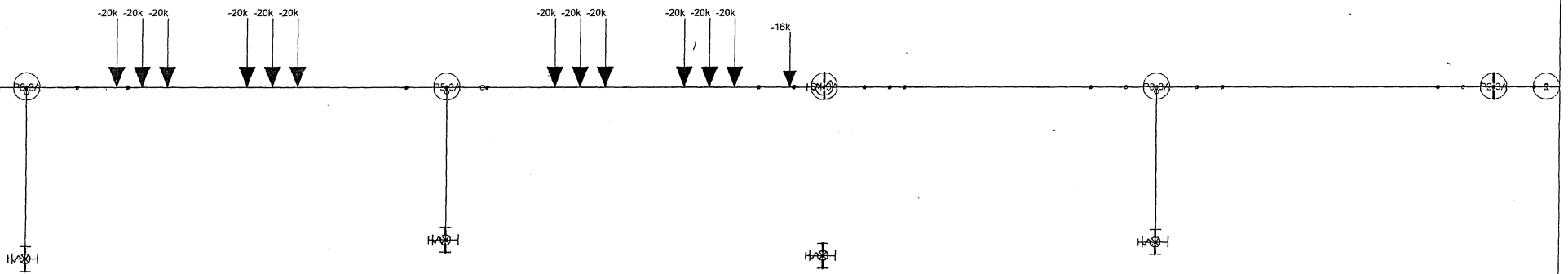
jdf

090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:12 AM

090147_3A_P456_GirderABeamA.r3d



1/5/10
S12/10

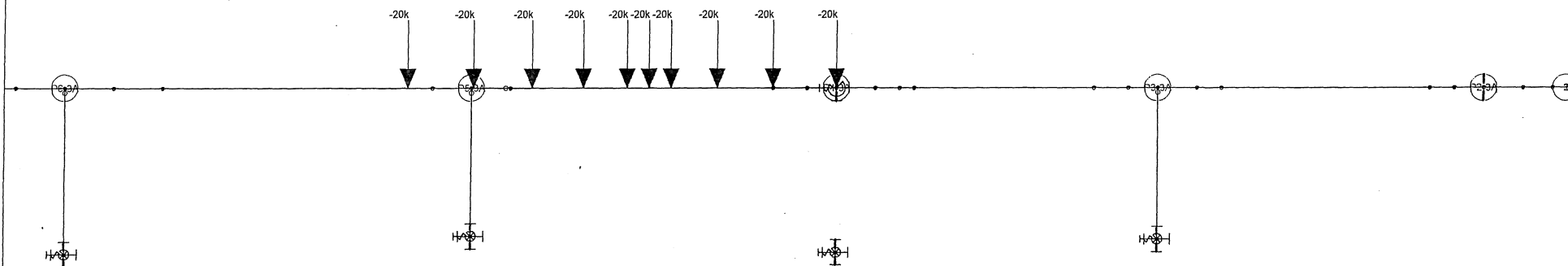
Loads: BLC 48, P4-3A C256b Tor

LHB
jdf
090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 26, 2010 at 11:40 AM

090147_3A_P456_GirderABeamA.r3d



beam
5/12/10

Loads: BLC 49, P4-3A C200] Tor

LHB

jdf

090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 19, 2010 at 11:12 AM

090147_3A_P456_GirderABeamA.r3d

601-109

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Mar 9, 2010
 11:04 AM
 Checked By: *CTM*

5/6/10

Joint Reactions (By Combination)

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	4	H1	0	19.811	0	0	0	0
2	4	P3-3C	0	19.85	0	0	0	0
3	4	P2-3C	0	31.954	0	0	0	0
4	4	P1-3C	0	35.627	0	0	0	0
5	4	P7-3A	0	18.944	0	0	0	0
6	4	P6-3A-FTG	0	30.545	0	0	0	0
7	4	P5-3A-FTG	0	21.006	0	0	0	0
8	4	P4-3A-FTG	0	0	0	0	0	0
9	4	P4-3A	0	50.739	0	0	0	-7.435
10	4	P3-3A-FTG	0	17.31	0	0	0	0
11	4	P2-3A	0	18.753	0	0	0	0
12	4	P1-3A	0	15.493	0	0	0	0
13	4	H5	0	0	0	0	0	0
14	4	Totals:	0	280.032	0			
15	4	COG (ft):	X: 379.79	Y: 0	Z: 0			
16	5	H1	0	-3.301	0	0	0	0
17	5	P3-3C	0	29.648	0	0	0	0
18	5	P2-3C	0	26.336	0	0	0	0
19	5	P1-3C	0	21.997	0	0	0	0
20	5	P7-3A	0	25.275	0	0	0	0
21	5	P6-3A-FTG	0	25.89	0	0	0	0
22	5	P5-3A-FTG	0	51.19	0	0	0	0
23	5	P4-3A-FTG	0	0	0	0	0	0
24	5	P4-3A	0	23.038	0	0	0	-82.28
25	5	P3-3A-FTG	0	21.854	0	0	0	0
26	5	P2-3A	0	21.293	0	0	0	0
27	5	P1-3A	0	20.856	0	0	0	0
28	5	H5	0	17.677	0	0	0	0
29	5	Totals:	0	281.754	0			
30	5	COG (ft):	X: 443.006	Y: 0	Z: 0			
31	6	H1	0	19.807	0	0	0	0
32	6	P3-3C	0	19.87	0	0	0	0
33	6	P2-3C	0	31.874	0	0	0	0
34	6	P1-3C	0	35.766	0	0	0	0
35	6	P7-3A	0	15.814	0	0	0	0
36	6	P6-3A-FTG	0	65.195	0	0	0	0
37	6	P5-3A-FTG	0	19.112	0	0	0	0
38	6	P4-3A-FTG	0	0	0	0	0	0
39	6	P4-3A	0	23.761	0	0	0	74.559
40	6	P3-3A-FTG	0	20.197	0	0	0	0
41	6	P2-3A	0	18.142	0	0	0	0
42	6	P1-3A	0	15.601	0	0	0	0
43	6	H5	0	0	0	0	0	0
44	6	Totals:	0	285.139	0			
45	6	COG (ft):	X: 367.586	Y: 0	Z: 0			

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Mar 9, 2010
 10:56 AM
 Checked By: *CSM*

HL-93 Truck

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	7	.026	7	0	7	0	7	0	7	0	7
2		min	0	7	-.275	7	0	7	0	7	0	7	0	7
3	P3-3C	max	0	7	1.392	7	0	7	0	7	0	7	0	7
4		min	0	7	-.13	7	0	7	0	7	0	7	0	7
5	P2-3C	max	0	7	.509	7	0	7	0	7	0	7	0	7
6		min	0	7	-5.458	7	0	7	0	7	0	7	0	7
7	P1-3C	max	0	7	66.843	7	0	7	0	7	0	7	0	7
8		min	0	7	-.885	7	0	7	0	7	0	7	0	7
9	P7-3A	max	0	7	71.5	7	0	7	0	7	0	7	0	7
10		min	0	7	-5.369	7	0	7	0	7	0	7	0	7
11	P6-3A-FTG	max	0	7	70.612	7	0	7	0	7	0	7	0	7
12		min	0	7	-8.289	7	0	7	0	7	0	7	0	7
13	P5-3A-FTG	max	0	7	71.335	7	0	7	0	7	0	7	0	7
14		min	0	7	-6.174	7	0	7	0	7	0	7	0	7
15	P4-3A-FTG	max	0	7	0	7	0	7	0	7	0	7	0	7
16		min	0	7	0	7	0	7	0	7	0	7	0	7
17	P4-3A	max	0	7	69.684	7	0	7	0	7	0	7	167.208	7
18		min	0	7	-6.968	7	0	7	0	7	0	7	-170.951	7
19	P3-3A-FTG	max	0	7	68.829	7	0	7	0	7	0	7	0	7
20		min	0	7	-6.018	7	0	7	0	7	0	7	0	7
21	P2-3A	max	0	7	66.023	7	0	7	0	7	0	7	0	7
22		min	0	7	-6.434	7	0	7	0	7	0	7	0	7
23	P1-3A	max	0	7	1.141	7	0	7	0	7	0	7	0	7
24		min	0	7	-5.551	7	0	7	0	7	0	7	0	7
25	H5	max	0	7	0	7	0	7	0	7	0	7	0	7
26		min	0	7	0	7	0	7	0	7	0	7	0	7
27	Totals:	max	0	7	72	7	0	7						
28		min	0	7	8	7	0	7						

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Mar 9, 2010
 11:00 AM
 Checked By: *CTM*

HL-93 Tandem

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	8	.019	8	0	8	0	8	0	8	0	8
2		min	0	8	-.205	8	0	8	0	8	0	8	0	8
3	P3-3C	max	0	8	1.037	8	0	8	0	8	0	8	0	8
4		min	0	8	-.095	8	0	8	0	8	0	8	0	8
5	P2-3C	max	0	8	.374	8	0	8	0	8	0	8	0	8
6		min	0	8	-4.067	8	0	8	0	8	0	8	0	8
7	P1-3C	max	0	8	49.596	8	0	8	0	8	0	8	0	8
8		min	0	8	-.651	8	0	8	0	8	0	8	0	8
9	P7-3A	max	0	8	54.136	8	0	8	0	8	0	8	0	8
10		min	0	8	-3.912	8	0	8	0	8	0	8	0	8
11	P6-3A-FTG	max	0	8	49.965	✓8	0	8	0	8	0	8	0	8
12		min	0	8	-6.638	8	0	8	0	8	0	8	0	8
13	P5-3A-FTG	max	0	8	53.982	✓8	0	8	0	8	0	8	0	8
14		min	0	8	-4.494	8	0	8	0	8	0	8	0	8
15	P4-3A-FTG	max	0	8	0	8	0	8	0	8	0	8	0	8
16		min	0	8	0	8	0	8	0	8	0	8	0	8
17	P4-3A	max	0	8	49.967	✓8	0	8	0	8	0	8	126.305	8
18		min	0	8	-5.253	8	0	8	0	8	0	8	-127.445	✓8
19	P3-3A-FTG	max	0	8	49.871	8	0	8	0	8	0	8	0	8
20		min	0	8	-4.486	8	0	8	0	8	0	8	0	8
21	P2-3A	max	0	8	49.779	8	0	8	0	8	0	8	0	8
22		min	0	8	-4.872	8	0	8	0	8	0	8	0	8
23	P1-3A	max	0	8	.864	8	0	8	0	8	0	8	0	8
24		min	0	8	-4.191	8	0	8	0	8	0	8	0	8
25	H5	max	0	8	0	8	0	8	0	8	0	8	0	8
26		min	0	8	0	8	0	8	0	8	0	8	0	8
27	Totals:	max	0	8	50	8	0	8						
28		min	0	8	25	8	0	8						

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Mar 9, 2010
 11:01 AM
 Checked By: CJM

HL-93 2 trucks at 50' spacing

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	9	.019	9	0	9	0	9	0	9	0	9
2		min	0	9	-.275	9	0	9	0	9	0	9	0	9
3	P3-3C	max	0	9	1.392	9	0	9	0	9	0	9	0	9
4		min	0	9	-.096	9	0	9	0	9	0	9	0	9
5	P2-3C	max	0	9	.375	9	0	9	0	9	0	9	0	9
6		min	0	9	-5.458	9	0	9	0	9	0	9	0	9
7	P1-3C	max	0	9	66.843	9	0	9	0	9	0	9	0	9
8		min	0	9	-.654	9	0	9	0	9	0	9	0	9
9	P7-3A	max	0	9	80.846	9	0	9	0	9	0	9	0	9
10		min	0	9	-4.556	9	0	9	0	9	0	9	0	9
11	P6-3A-FTG	max	0	9	97.984	9	0	9	0	9	0	9	0	9
12		min	0	9	-8.289	9	0	9	0	9	0	9	0	9
13	P5-3A-FTG	max	0	9	81.087	9	0	9	0	9	0	9	0	9
14		min	0	9	-5.207	9	0	9	0	9	0	9	0	9
15	P4-3A-FTG	max	0	9	0	9	0	9	0	9	0	9	0	9
16		min	0	9	0	9	0	9	0	9	0	9	0	9
17	P4-3A	max	0	9	74.456	9	0	9	0	9	0	9	136.97	9
18		min	0	9	-6.968	9	0	9	0	9	0	9	-156.496	9
19	P3-3A-FTG	max	0	9	69.584	9	0	9	0	9	0	9	0	9
20		min	0	9	-5.509	9	0	9	0	9	0	9	0	9
21	P2-3A	max	0	9	66.023	9	0	9	0	9	0	9	0	9
22		min	0	9	-5.227	9	0	9	0	9	0	9	0	9
23	P1-3A	max	0	9	.927	9	0	9	0	9	0	9	0	9
24		min	0	9	-5.551	9	0	9	0	9	0	9	0	9
25	H5	max	0	9	0	9	0	9	0	9	0	9	0	9
26		min	0	9	0	9	0	9	0	9	0	9	0	9
27	Totals:	max	0	9	144	9	0	9						
28		min	0	9	8	9	0	9						



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Duluth, Minnesota 55802
218 727-8446
Fax 218 727-8456
www.LHBcorp.com

250 3rd Avenue North, Suite 450
Minneapolis, Minnesota 55401
612 338-2029
Fax 612 338-2088

PROJECT MnDOT SS - 69801J - 2 trucks @ 50' space
PROJECT # 090147 DATE 3/9/10 BY jdf SHEET NO. _____ OF _____
✓ csm 5/12/10

The Location of the trucks were checked
for P4-3A to verify all of the axles
were in a position which increased the
Reaction at P4-3A. ✓

checked on
 5/14/10 + updated
 + rechecked 6/6/10

Joint Reactions (By Item)

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	11	H1	0	0	0	0	0	0
2	11	P3-3C	0	0	0	0	0	0
3	11	P2-3C	0	0	0	0	0	0
4	11	P1-3C	0	0	0	0	0	0
5	11	P7-3A	0	0	0	0	0	0
6	11	P6-3A-FTG	-407	0	0	0	0	13.914
7	11	P5-3A-FTG	-593	0	0	0	0	18.044
8	11	P4-3A-FTG	0	0	0	0	0	0
9	11	P4-3A	-624	0	0	0	0	0
10	11	P3-3A-FTG	-376	0	0	0	0	11.678
11	11	P2-3A	0	0	0	0	0	0
12	11	P1-3A	0	0	0	0	0	0
13	11	H5	0	0	0	0	0	0
14	11	Totals:	-2	0	0			
15	11	COG (ft):	NC	NC	NC			

Revised P6 spring to 200.4 k/in
 Horizontal load applied at P6.

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

May 21, 2010
 1:09 PM
 Checked By: CJM

initial check 5/11/10
 recheck 6/24/10

Joint Reactions (By Item)

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	11	H1	0	0	0	0	0	0
2	11	P3-3C	0	0	0	0	0	0
3	11	P2-3C	0	0	0	0	0	0
4	11	P1-3C	0	0	0	0	0	0
5	11	P7-3A	0	0	0	0	0	0
6	11	P6-3A-FTG	-377	0	0	0	0	12.901
7	11	P5-3A-FTG	-623	0	0	0	0	18.945
8	11	P4-3A-FTG	0	0	0	0	0	0
9	11	P4-3A	-624	0	0	0	0	0
10	11	P3-3A-FTG	-376	0	0	0	0	11.678
11	11	P2-3A	0	0	0	0	0	0
12	11	P1-3A	0	0	0	0	0	0
13	11	H5	0	0	0	0	0	0
14	11	Totals:	-2	0	0			
15	11	COG (ft):	NC	NC	NC			

Revised P6 spring to 200.4 k/in
 horizontal load applied at P5

Horizontal Load for Shared Braking Forces

5/11/10

Joint Reactions (By Combination)

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	11	H1	0	0	0	0	0	0
2	11	P3-3C	0	0	0	0	0	0
3	11	P2-3C	0	0	0	0	0	0
4	11	P1-3C	0	0	0	0	0	0
5	11	P7-3A	0	0	0	0	0	0
6	11	P6-3A-FTG	-347	0	0	0	0	11.87
7	11	P5-3A-FTG	-653	0	0	0	0	19.862
8	11	P4-3A-FTG	0	0	0	0	0	0
9	11	P4-3A	-624	0	0	0	0	0
10	11	P3-3A-FTG	-376	0	0	0	0	11.678
11	11	P2-3A	0	0	0	0	0	0
12	11	P1-3A	0	0	0	0	0	0
13	11	H5	0	0	0	0	0	0
14	11	Totals:	-2	0	0			
15	11	COG (ft):	NC	NC	NC			

Note if Horizontal Load is applied @ P6-3A
 instead of P5-3A, then
 $P6-3A-FTG = -322$
 $P5-3A-FTG = -678$ ← use for Pier 5
 ∴ leave Pier 5 as is in calcs.

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Checked

HL-93 Truck to cause Maximum
 Y Reaction at Pier 4

Joint Reactions (By Combination)

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	12	H1	0	0	0	0	0	0
2	12	P3-3C	0	0	0	0	0	0
3	12	P2-3C	0	0	0	0	0	0
4	12	P1-3C	0	-0.001	0	0	0	0
5	12	P7-3A	0	.033	0	0	0	0
6	12	P6-3A-FTG	0	-.233	0	0	0	0
7	12	P5-3A-FTG	0	1.959	0	0	0	0
8	12	P4-3A-FTG	0	0	0	0	0	0
9	12	P4-3A	0	69.683	0	0	0	-8.68
10	12	P3-3A-FTG	0	.676	0	0	0	0
11	12	P2-3A	0	-.141	0	0	0	0
12	12	P1-3A	0	.025	0	0	0	0
13	12	H5	0	0	0	0	0	0
14	12	Totals:	0	72	0			
15	12	COG (ft):	X: 555.728	Y: 0	Z: 0			

511311

Joint Reactions (By Combination)

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	13	H1	0	0	0	0	0	0
2	13	P3-3C	0	-0.003	0	0	0	0
3	13	P2-3C	0	.011	0	0	0	0
4	13	P1-3C	0	-.019	0	0	0	0
5	13	P7-3A	0	.435	0	0	0	0
6	13	P6-3A-FTG	0	-3.095	0	0	0	0
7	13	P5-3A-FTG	0	25.992	0	0	0	0
8	13	P4-3A-FTG	0	0	0	0	0	0
9	13	P4-3A	0	53.649	0	0	0	-170.951
10	13	P3-3A-FTG	0	-6.018	0	0	0	0
11	13	P2-3A	0	1.274	0	0	0	0
12	13	P1-3A	0	-.226	0	0	0	0
13	13	H5	0	0	0	0	0	0
14	13	Totals:	0	72	0			
15	13	COG (ft):	X: 529.237	Y: 0	Z: 0			
16	14	H1	0	19.811	0	0	0	0
17	14	P3-3C	0	19.85	0	0	0	0
18	14	P2-3C	0	31.955	0	0	0	0
19	14	P1-3C	0	35.626	0	0	0	0
20	14	P7-3A	0	18.983	0	0	0	0
21	14	P6-3A-FTG	0	30.273	0	0	0	0
22	14	P5-3A-FTG	0	23.29	0	0	0	0
23	14	P4-3A-FTG	0	0	0	0	0	0
24	14	P4-3A	0	23.702	0	0	0	-92.104
25	14	P3-3A-FTG	0	21.508	0	0	0	0
26	14	P2-3A	0	21.366	0	0	0	0
27	14	P1-3A	0	20.843	0	0	0	0
28	14	H5	0	17.677	0	0	0	0
29	14	Totals:	0	284.883	0			
30	14	COG (ft):	X: 402.942	Y: 0	Z: 0			

LC 13 is HL-93 truck positioned for max Torque.

LC 14 is Lane load, patterned for max Torque.



21 West Superior Street, Suite 500
Duluth, Minnesota 55802
218 727-8446
Fax 218 727-8456
www.LHBcorp.com

250 3rd Avenue North, Suite 450
Minneapolis, Minnesota 55401
612 338-2029
Fax 612 338-2088

PROJECT MDOT SS-69801 J - Risa Load Combinations
PROJECT # 090147 DATE 4/19/10 BY jdf SHEET NO. _____ OF _____

Load Combinations:

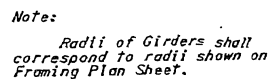
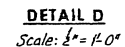
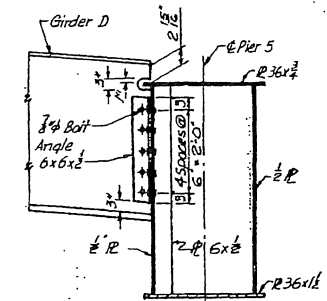
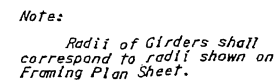
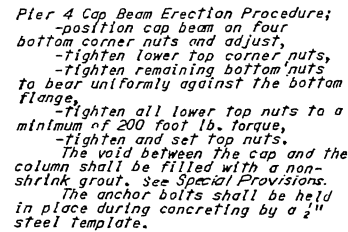
LC 15 - LC 33 are moving Load combinations for posting & permit trucks. See the posting / permit area of calcs for results.

LC 34 - LC 52 are the posting & permit trucks located in positions to cause the maximum reaction at pier 4-3A. See the posting / permit area of calcs for results.

LC 53 - LC 71 are the posting & permit trucks located in the position to cause the maximum Torque at pier 4-3A. See the posting / permit area of the calcs for results.

LC 72 - LC 77 are moving load combinations for permit trucks with variable axle distances. These LC's use the longest axle distance to check if it controls for Reaction or torsion. See the posting / permit area of calcs for results.

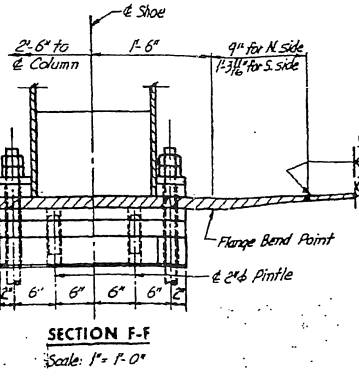
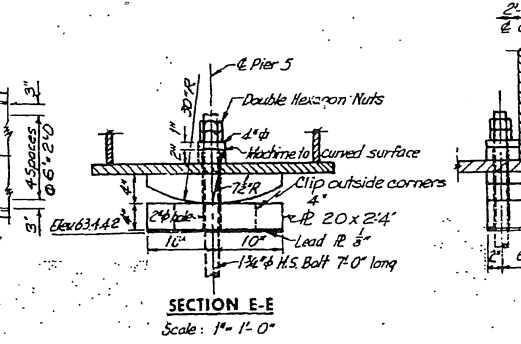
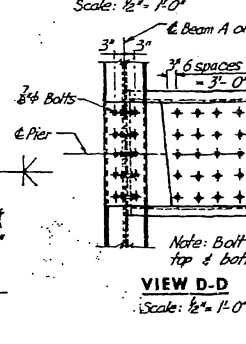
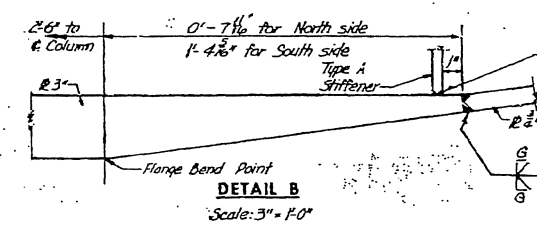
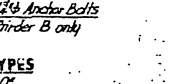
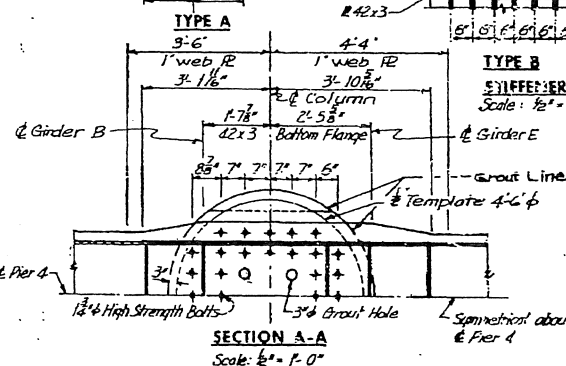
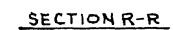
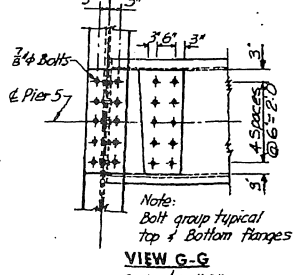
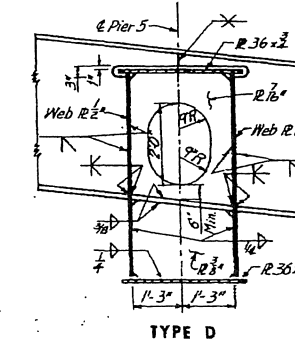
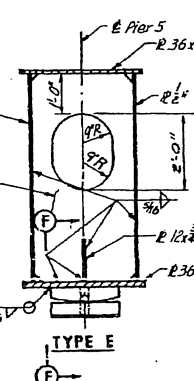
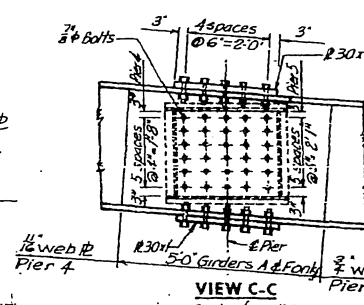
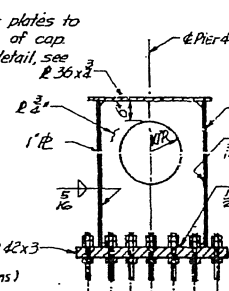
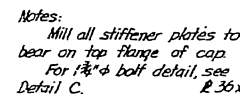
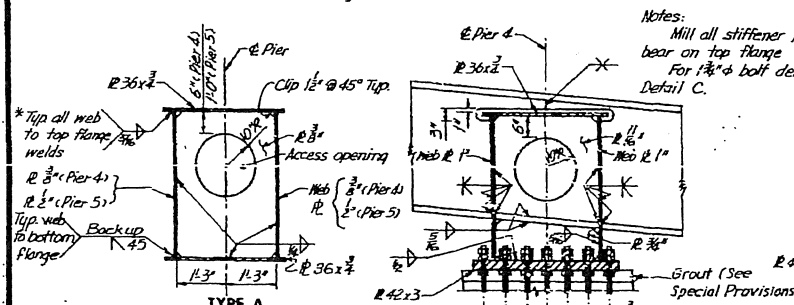
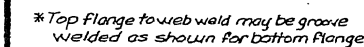
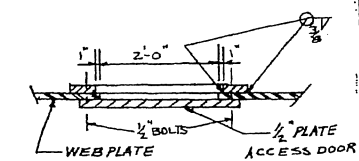
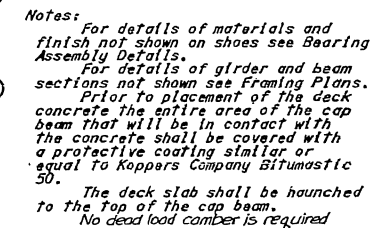
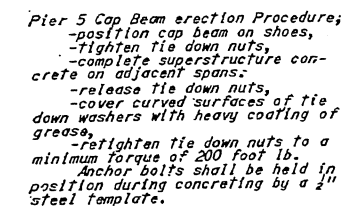
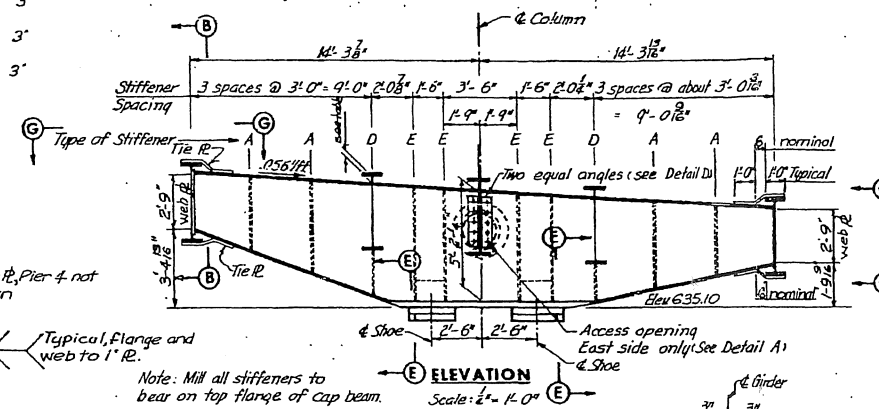
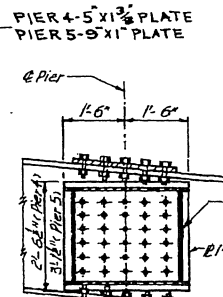
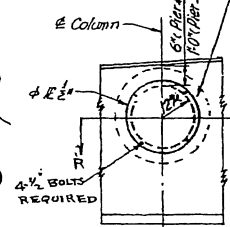
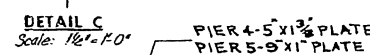
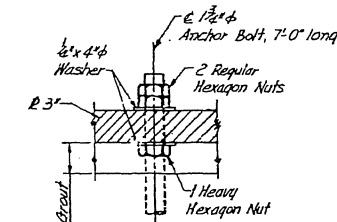
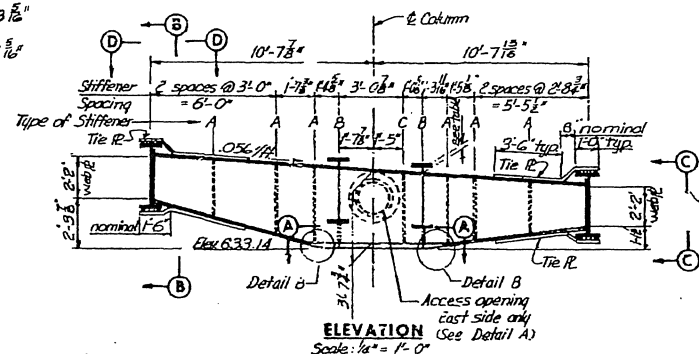
69801J-3A-P4
General



Girder Dimension between flanges
 @ 1 girder & 1 pier 4.

A	$3 \frac{5}{16}'$
B	$3 \frac{5}{16}"$
E	$3 \frac{5}{16}"$
F	$3 \frac{5}{16}'$

(D)



H.N.T.B. BR. NO. 2A, 2C-2K, 3A-3E

TRUNK HIGHWAY NO. 35
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS

INTERSTATE ROUTES IN DULUTH

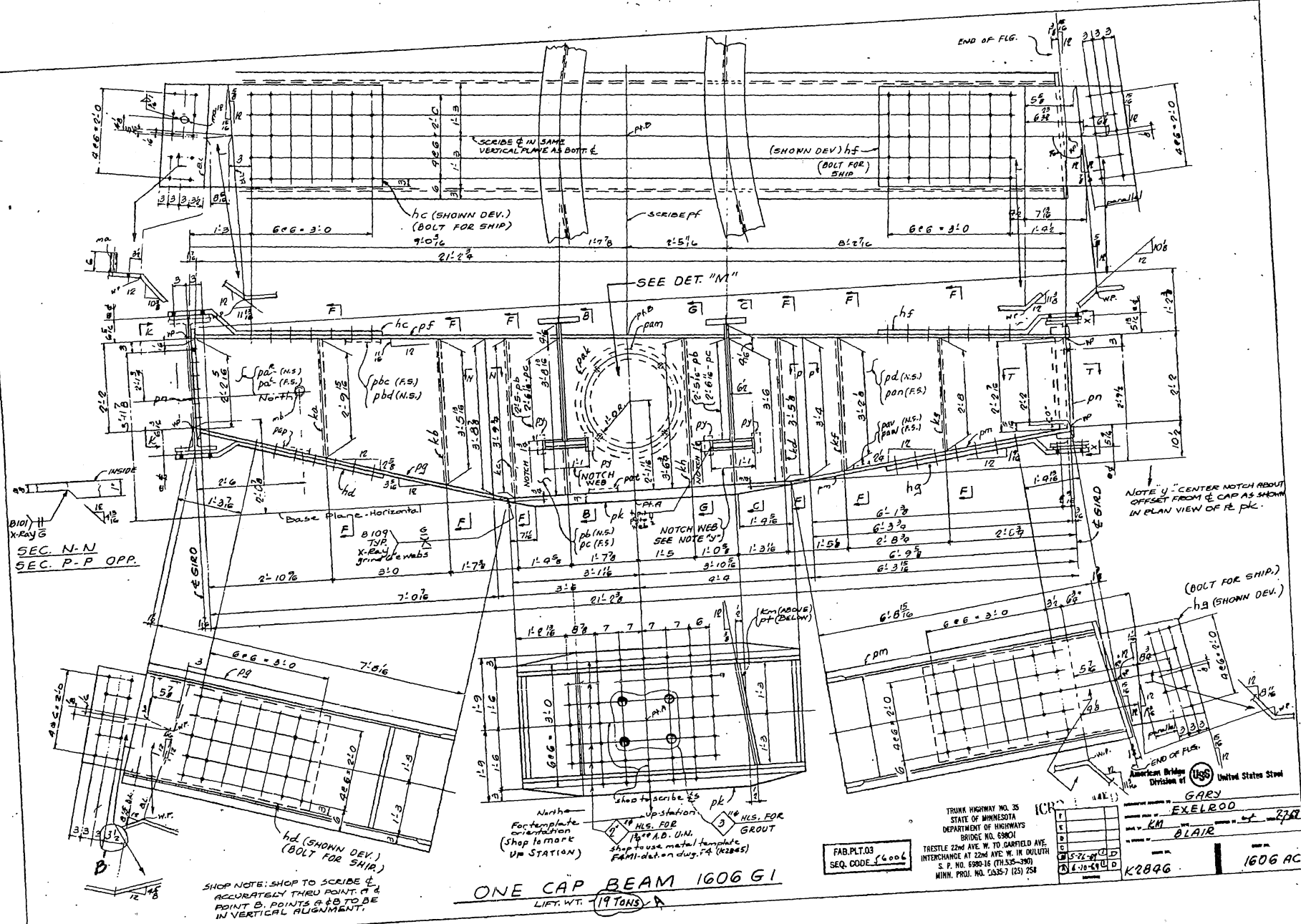
BRIDGE NO. 69801

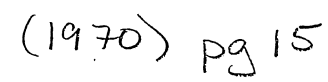
STEEL CAP BEAM DETAILS
PIER 4 AND PIER 5
BRIDGE 3A

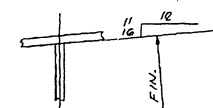
APPROVED: 7-30-68

SHEET NO.86 OF 189 SHEETS	69801-
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DES.	TCY
DCH	RC
DR	TCY
CH	TCY







OTHER REAMING AS PER MMD 2471.51 & 2471.52 & 2471.53.

CAMBER : NONE

INSPECTION : SHOP INSPECTION BY M.H.D

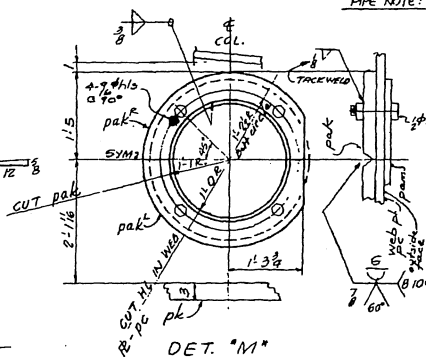
MAGNETIC PARTICLE INSP. : PER MMD 2471.374 d2 & SPECIAL PROVISIONS. (100% BRS STIFFS & 10% WEB & FLS WELDS).

RADIOGRAPHIC INSP. : MMD 2471.374 d4 & SPECIAL PROVISIONS. (100% ALL BUTT WELDS - INDICATED "X-RAY" ON DWGS).

WELDING : PER MMD 2471.51, 2471.52, 2471.53 & SPECIAL PROVISIONS. REMOVE ALL SHOP TACK WELDING ON SPURCE PLATES.

PRINT NOTE
ONE COAT INORGANIC ZINC LEAD SILICATE
COATING ON THE INSIDE PER SPECS.
- ONE COAT RED LEAD (MND 350G-SANDBLA
ON THE OUTSIDE.
See Special Transions page 195B for sand
Wastage inside of cap girder

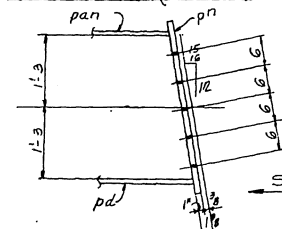
NOTE "A" - HOLES AT SPLICES MAY BE DRILLED
FULL SIZE FROM THE SOLID IN THE MAIN
MATERIAL USING SPLICE PLATES AS
TEMPLETS WHICH HAVE BEEN DRILLED
- FULL SIZE USING NUMERICAL CONTROLLED
TAPE DRILL OR SUPPLEMENTED AND REAMED.



DET. "M"

VIEW K-K

VIEW X-X (OPP. HD.)



SEC. T-T

LINE	ITEM	MATERIAL			FROM JOB NO.	TAPPING OR REPAIRING SIZE	TAPPING PROCESSED OR OTHERWISE NOTED	REMARKS	SHEET	PAGE	CANNOT BE REPRODUCED IN THE JOB
		DESCRIPTION	QUANTITY	UNIT							
1	1	1	1	1							
2	2	2	2	2							
3	3	3	3	3							
4	4	4	4	4							
5	5	5	5	5							
6	6	6	6	6							
7	7	7	7	7							
8	8	8	8	8							
9	9	9	9	9							
10	10	10	10	10							
11	11	11	11	11							
12	12	12	12	12							
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44	44	44	44	44							
45	45	45	45	45							
46	46	46	46	46							
47	47	47	47	47							
48	48	48	48	48							

DIV. 1
PIER 2
UNIT E-3A

PARTY: See parent note
 BOMB EXPLOSIVE: YES

MICROFILMED

TRUNK HIGHWAY NO. 35
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS
BRIDGE NO. 63801
TRESTLE 22nd AVE. W. TO GARFIELD AVE.
INTERCHANGE AT 22nd AVE. W. IN DULUTH
S. P. NO. 6380-16 (71.535-390)
BAYVIEW PROJ. NO. 63535-7 (75) 258

FAR.	03	REQ.	5600	F
PLT.		CODE		E
	NO	LAST CONTENT		

American Bridge
Division of United States Steel

0		THE	HE	LE	END	END
C						

FABRICK TOWN ADDRESS (R) GARY
EVEL ROD

A			40
PLANT	EXCEPTION	ON	
REV. NO.	REV. NO.	CONTROL	① 42

ANALYSIS MADE BY ELLENOR
 MADE BY KM DATE 1/27/68 CHECKED BY WTF DATE 2/6/68
BLAIR

FOR LOCATION OF SHIPPING PIECES SHOWN ON THIS SECTION PLANS.

OF CHANGE OF

UPPER SOIL

DOWNER SOIL

E1601

K2846	1606C
-------	-------

1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 2680, 26

(A) [C]

1.

(1970)

916

516



21 West Superior Street, Suite 500
Duluth, Minnesota 55802
218 727-8446
Fax 218 727-8456
www.LHBcorp.com

250 3rd Avenue North, Suite 450
Minneapolis, Minnesota 55401
612 338-2029
Fax 612 338-2088

PROJECT MnDOT SS-69801J-P4-3A-Controlling Load Combination
PROJECT # 090147 DATE 1/19/10 BY jdf SHEET NO. 5/13/10 OF 5

Design Pier Cap Loading for

- ① 2 lanes of lane + truck loading
- ② 2 lanes of lane + tandem loading
- ③ 2 lanes of 0.9 lane + 0.9 (2 truck @ 50')

Reactions due to Lane =	50.7 k ✓
" " " Truck =	69.7 k ✓
" " " Tandem =	50.0 k ✓
" " " 2 trucks @ 50' =	74.4 k ✓

minimally
affected
by RISA
Revision.
will not
Revise here

What will control?

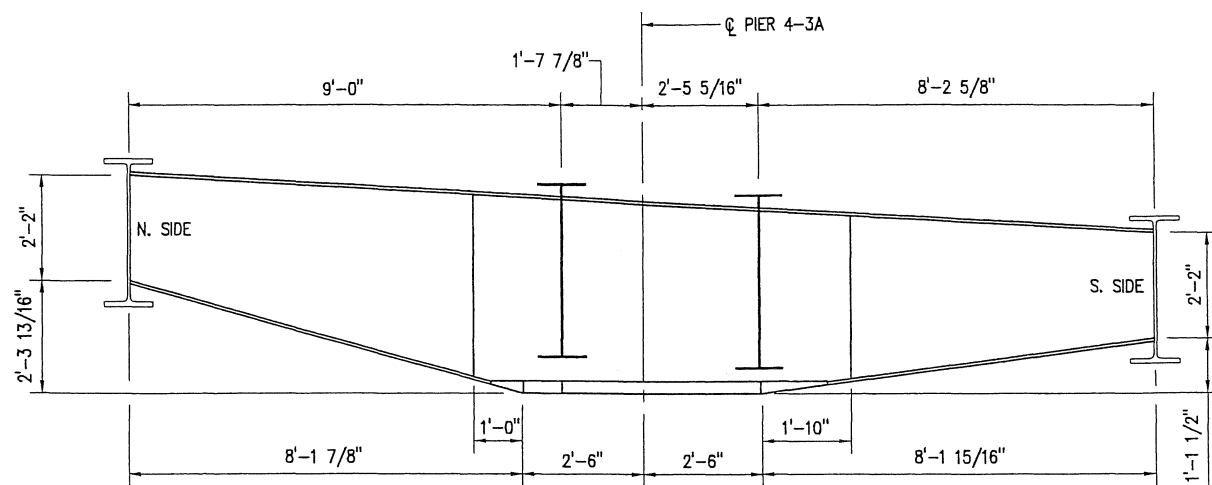
Impact factor is $1 + \frac{33}{100} = 1.33$ to ✓
truck or tandem loads only (not lane)

Reaction per lane:

- ① $50.7 + 1.33 \times 69.7 = 143.4 \text{ k} \checkmark$
- ② $50.7 + 1.33 \times 50.0 = 117.2 \text{ k} \checkmark$
- ③ $0.9 \times 50.7 + 0.9 \times 1.33 \times 74.4 = 134.7 \text{ k} \checkmark$

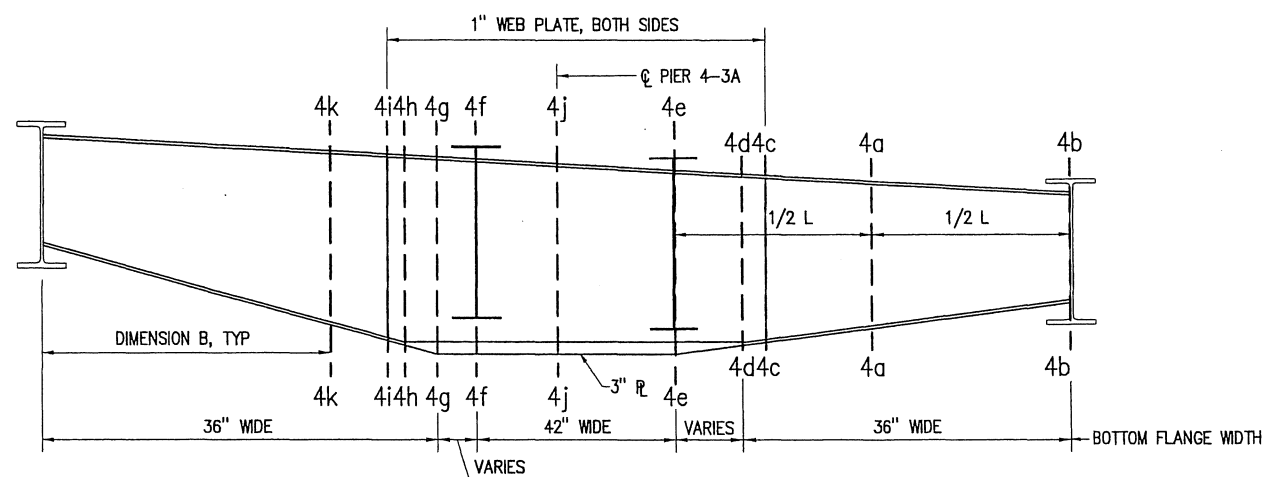
← controls

1.0 Lane + 1.0 Truck controls



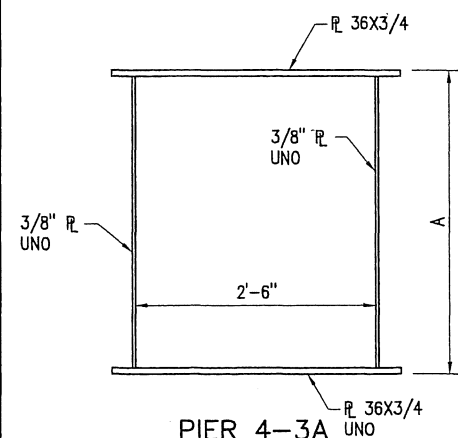
PIER 4-3A GEOMETRY

SCALE: 0 2'



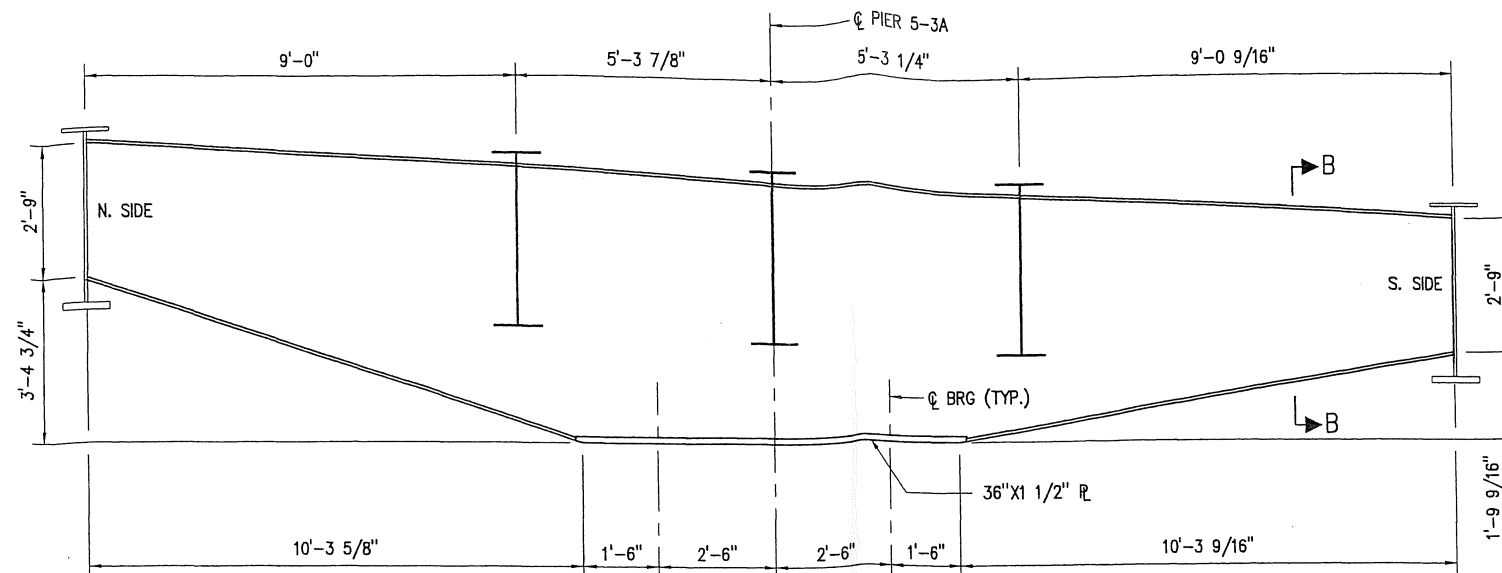
PIER 4-3A SECTION CUTS

SCALE: 0 2'



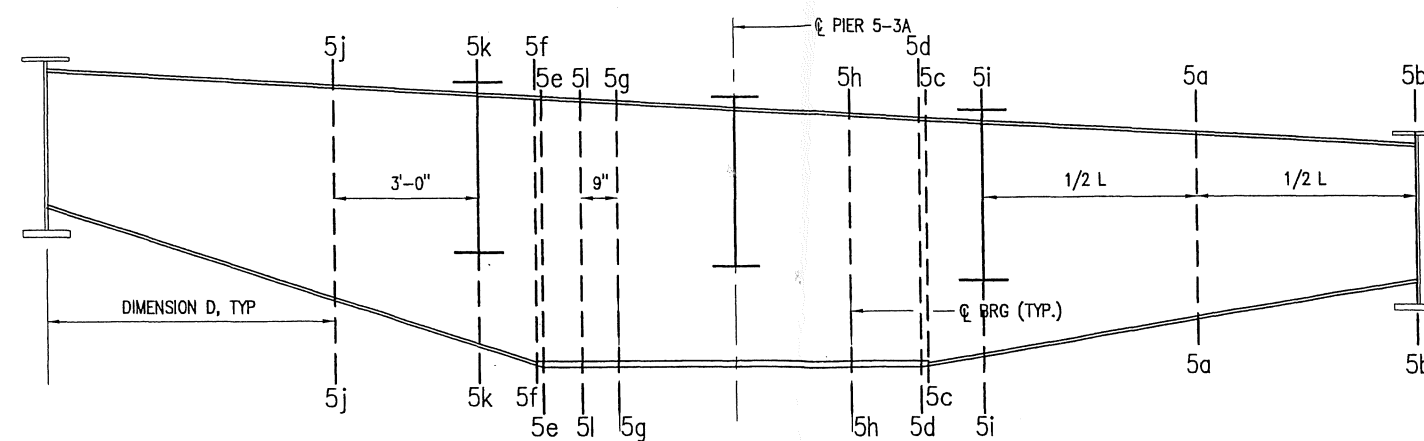
SCALE: 0 1'

DIMENSION A	DIMENSION B
4a = 3'-0 5/8"	4a = 17'-2 3/8"
4b = 2'-3 1/2"	4b = 21'-3 7/16"
4c = 3'-5 5/8"	4c = 14'-11 7/8"
4d = 3'-6 11/16"	4d = 14'-6 3/16"
4e = 3'-9 3/4"	4e = 13'-1 1/2"
4f = 4'-0 1/2"	4f = 9'-0"
4g = 4'-1 1/16"	4g = 8'-2 1/4"
4h = 3'-11 3/8"	4h = 7'-6 3/16"
4i = 3'-10 7/16"	4i = 7'-1 7/8"
4j = 3'-11 3/8"	4j = 10'-7 7/8"
4k = 3'-7 3/8"	4k = 6'-0"



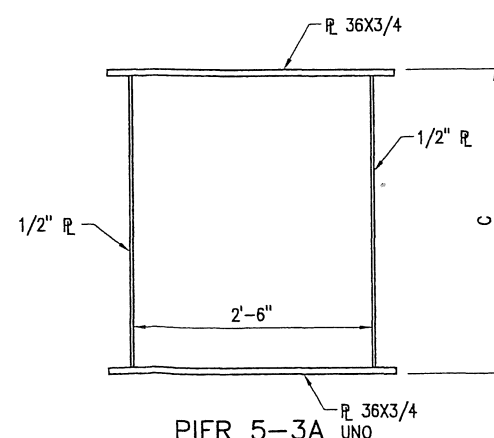
PIER 5-3A GEOMETRY

SCALE: 0 2'



PIER 5-3A SECTION CUTS

SCALE: 0 2'



SCALE: 0 1'

DIMENSION C	DIMENSION D
5a = 3'-9 15/16"	5a = 24'-1 3/16"
5b = 2'-10 1/2"	5b = 28'-7 1/4"
5c = 5'-1 7/8"	5c = 18'-5 5/8"
5d = 5'-2 1/4"	5d = 18'-3 7/8"
5e = 5'-7 5/8"	5e = 10'-3 13/16"
5f = 5'-7 3/16"	5f = 10'-2 5/16"
5g = 5'-6 9/16"	5g = 11'-9 7/8"
5h = 5'-3 1/4"	5h = 16'-9 7/8"
5i = 4'-10 13/16"	5i = 19'-7 1/8"
5j = 4'-5 11/16"	5j = 6'-0"
5k = 5'-3 5/16"	5k = 9'-0"
5l = 5'-7 1/8"	5l = 11'-0 7/8"

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

NAME: _____ LIC. NO. _____ DATE: _____

TITLE: STEEL CAP BEAM
PIER 4 AND PIER 5 BRIDGE 3A

DES: _____ DR: CJM
CHK: _____ CHK: _____
APPROVED: _____

Bridge No. 69801

Sheet No. ___ of ___ Sheets

J-6

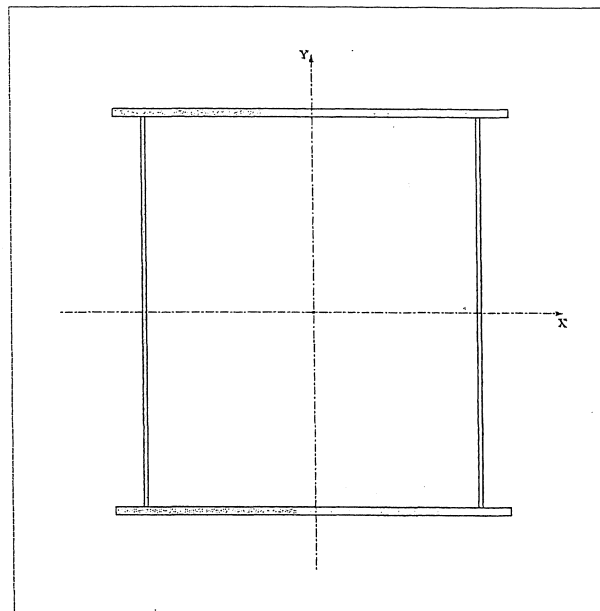
5/13/10

Section Properties: BR3A-4a

Number of Shapes	=	4	
Total Width	=	36.000	in ✓
Total Height	=	36.625	in ✓
Center, X _o	=	0.000	in
Center, Y _o	=	0.000	in
X-bar(Right)	=	18.000	in
X-bar(Left)	=	18.000	in
Y-bar(Top)	=	18.313	in
Y-bar(Bot)	=	18.313	in

Equivalent Properties:

Area, A _x	=	80.344	in ²
Inertia, I _{xx}	=	2.009E+004	in ⁴
Inertia, I _{yy}	=	1.191E+004	in ⁴
Inertia, I _{xy}	=	0.000	in ⁴
Modulus, S _x (Top)	=	1096.83	in ³
Modulus, S _x (Bot)	=	1096.83	in ³
Modulus, S _y (Left)	=	661.60	in ³
Modulus, S _y (Right)	=	661.60	in ³
Radius, r _x	=	15.811	in
Radius, r _y	=	12.175	in
Plastic Modulus, Z _x	=	1199.96	in ³
Plastic Modulus, Z _y	=	886.10	in ³
Torsional, J	=	11.279	in ⁴



Section Diagram

⚡ Not correct for closed Section. $J = 17441 \text{ in}^4$, see attached.

Section Used in Risa 3D model
 of Beam Cap

J-7

Company : LHB
 Designer : jdf
 Job Number: 090147

Feb 2, 2010
 13:26 PM
 Checked By: CJM

5/13/10

Basic Properties of Shapes in Section: BR3A-4a (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	36.000 ✓	36.000 ✓	0.375 ✓	0.375 ✓
Height (in)	0.750 ✓	0.750 ✓	35.125 ✓	35.125 ✓
Xo (in)	0.000	0.000	-15.188 ✓	15.188 ✓
Yo (in)	17.938 ✓	-17.938 ✓	0.000	0.000
Ax (in ²)	27.000	27.000	13.172	13.172
Ixx (in ⁴)	1.266	1.266	1354.25	1354.25
Iyy (in ⁴)	2916.00	2916.00	0.154	0.154

Additional Properties of Shapes in Section: BR3A-4a (Local Axis, for n=1)

Sx-Top (in ³)	3.375	3.375	77.110	77.110
Sy-Right (in ³)	162.00	162.00	0.823	0.823
rx (in)	0.217	0.217	10.140	10.140
ry (in)	10.392	10.392	0.108	0.108
Zx (in ³)	5.063	5.063	115.67	115.67
Zy (in ³)	243.00	243.00	1.235	1.235
J (in ⁴)	0.000E+000	0.000E+000	0.000E+000	0.000E+000



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PROJECT MnDOT SS-69801J-P4-3A - Section 4a J value

PROJECT # 090147 DATE 3/8/10 BY jdF SHEET NO. 5/13/10 OF 5/13/10

Torsion Constant

$$J = \frac{2 t_1 t_2 b^2 h^2}{b t_2 + h t_1} = \frac{2 \times .75 \times .375 \times 30.375^2 \times 35.875^2}{30.375 \times .375 + 35.875 \times .75}$$

$$t_1 = .75" \checkmark$$

$$t_2 = .375" \checkmark$$

$$b = 30.375" \checkmark$$

$$h = 35.875" \checkmark$$

$$J = 17441 \text{ in}^4 \checkmark \text{ Use } 17440 \text{ in}^4 \checkmark$$

We will need to modify the J in the Pier cap model
in Risa 3D

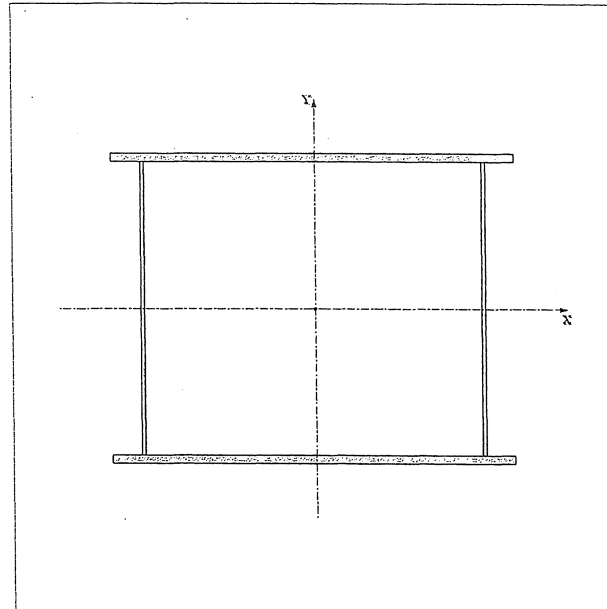
5/13/10

Section Properties: BR3A-4b

Number of Shapes	=	4	
Total Width	=	36.000	in ✓
Total Height	=	27.500	in ✓
Center, Xo	=	0.000	in
Center, Yo	=	0.000	in
X-bar(Right)	=	18.000	in
X-bar(Left)	=	18.000	in
Y-bar(Top)	=	13.750	in
Y-bar(Bot)	=	13.750	in

Equivalent Properties:

Area, Ax	=	73.500	in^2
Inertia, Ixx	=	1.076E+004	in^4
Inertia, Iyy	=	1.033E+004	in^4
Inertia, Ixy	=	0.000	in^4
Modulus, Sx(Top)	=	782.63	in^3
Modulus, Sx(Bot)	=	782.63	in^3
Modulus, Sy(Left)	=	573.98	in^3
Modulus, Sy(Right)	=	573.98	in^3
Radius, rx	=	12.100	in
Radius, ry	=	11.856	in
Plastic Modulus, Zx	=	849.00	in^3
Plastic Modulus, Zy	=	782.21	in^3
Torsional, J	=	10.957	in^4



Section Diagram

$$wt = 73.5 \text{ in}^2 \div (12 \text{ in})^2 \times 490 \text{ pcf} \times 1.2 = 300 \text{ pcf} \checkmark$$

0.1 for stiffeners
 0.1 for misc other

J-10

Company : LHB
 Designer : jdf
 Job Number: 090147

Feb 2, 2010
 13:26 PM
 Checked By: CSM

5/15/10

Basic Properties of Shapes in Section: BR3A-4b (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	36.000 ✓	36.000 ✓	0.375 ✓	0.375 ✓
Height (in)	0.750 ✓	0.750 ✓	26.000 ✓	26.000 ✓
Xo (in)	0.000	0.000	-15.190 ✓	15.190 ✓
Yo (in)	13.375 ✓	-13.375 ✓	0.000	0.000
Ax (in^2)	27.000	27.000	9.750	9.750
Ixx (in^4)	1.266	1.266	549.25	549.25
Iyy (in^4)	2916.00	2916.00	0.114	0.114

Additional Properties of Shapes in Section: BR3A-4b (Local Axis, for n=1)

Sx-Top (in^3)	3.375	3.375	42.250	42.250
Sy-Right (in^3)	162.00	162.00	0.609	0.609
rx (in)	0.217	0.217	7.506	7.506
ry (in)	10.392	10.392	0.108	0.108
Zx (in^3)	5.063	5.063	63.375	63.375
Zy (in^3)	243.00	243.00	0.914	0.914
J (in^4)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

J-11

Company : LHB
 Designer : jdf
 Job Number: 090147

Feb 2, 2010
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 Checked By: CSM

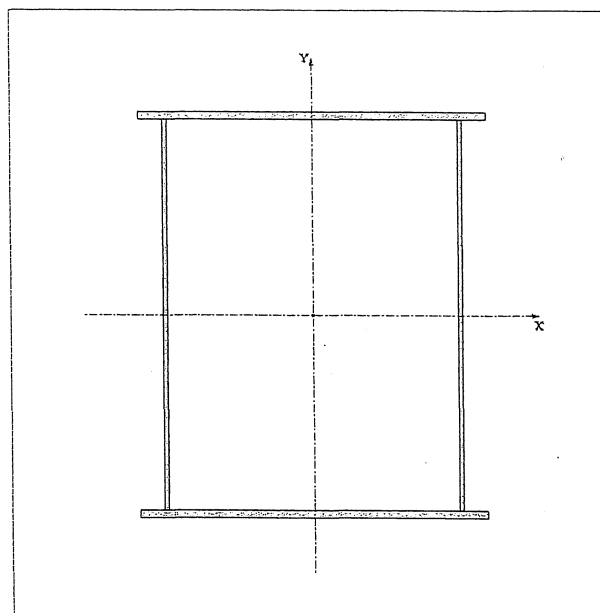
5/13/10

Section Properties: BR3A-4c

Number of Shapes	=	4	
Total Width	=	36.000	in ✓
Total Height	=	41.625	in ✓
Center, Xo	=	0.000	in
Center, Yo	=	0.000	in
X-bar(Right)	=	18.000	in
X-bar(Left)	=	18.000	in
Y-bar(Top)	=	20.813	in
Y-bar(Bot)	=	20.813	in

Equivalent Properties:

Area, Ax	=	84.094	in^2
Inertia, Ixx	=	2.660E+004	in^4
Inertia, Iyy	=	1.277E+004	in^4
Inertia, Ixy	=	0.000	in^4
Modulus, Sx(Top)	=	1277.86	in^3
Modulus, Sx(Bot)	=	1277.86	in^3
Modulus, Sy(Left)	=	709.65	in^3
Modulus, Sy(Right)	=	709.65	in^3
Radius, rx	=	17.784	in
Radius, ry	=	12.325	in
Plastic Modulus, Zx	=	1405.50	in^3
Plastic Modulus, Zy	=	943.05	in^3
Torsional, J	=	11.455	in^4



Section Diagram

$$wt = 84.1 \div 144 \times 490 \times 1.2 = 343 \text{ plf} \quad \checkmark$$

Company : LHB
 Designer : jdf
 Job Number: 090147

Feb 2, 2010
 13:26 PM
 Checked By: *CJM*

5/13/10

Basic Properties of Shapes in Section: BR3A-4c (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	36.000 ✓	36.000 ✓	0.375 ✓	0.375 ✓
Height (in)	0.750 ✓	0.750 ✓	40.125 ✓	40.125 ✓
Xo (in)	0.000	0.000	-15.188 ✓	15.188 ✓
Yo (in)	20.438 ✓	-20.438 ✓	0.000	0.000
Ax (in^2)	27.000	27.000	15.047	15.047
Ixx (in^4)	1.266	1.266	2018.81	2018.81
Iyy (in^4)	2916.00	2916.00	0.176	0.176

Additional Properties of Shapes in Section: BR3A-4c (Local Axis, for n=1)

Sx-Top (in^3)	3.375	3.375	100.63	100.63
Sy-Right (in^3)	162.00	162.00	0.940	0.940
rx (in)	0.217	0.217	11.583	11.583
ry (in)	10.392	10.392	0.108	0.108
Zx (in^3)	5.063	5.063	150.94	150.94
Zy (in^3)	243.00	243.00	1.411	1.411
J (in^4)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

J-13

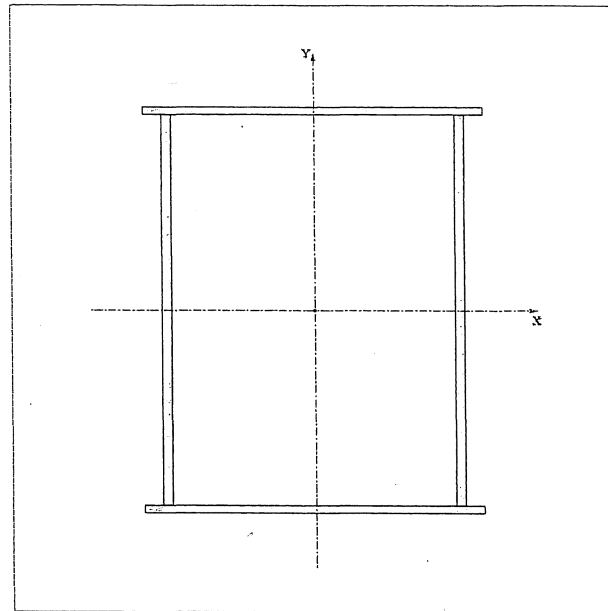
5/13/10

Section Properties: BR3A-4d

Number of Shapes	=	4	
Total Width	=	36.000	✓ in
Total Height	=	42.688	✓ in
Center, Xo	=	0.000	in
Center, Yo	=	0.000	in
X-bar(Right)	=	18.000	in
X-bar(Left)	=	18.000	in
Y-bar(Top)	=	21.344	in
Y-bar(Bot)	=	21.344	in

Equivalent Properties:

Area, Ax	=	136.38	in^2
Inertia, Ixx	=	3.539E+004	in^4
Inertia, Iyy	=	2.563E+004	in^4
Inertia, Ixy	=	0.000	in^4
Modulus, Sx(Top)	=	1658.14	in^3
Modulus, Sx(Bot)	=	1658.14	in^3
Modulus, Sy(Left)	=	1423.86	in^3
Modulus, Sy(Right)	=	1423.86	in^3
Radius, rx	=	16.109	in
Radius, ry	=	13.709	in
Plastic Modulus, Zx	=	1980.52	in^3
Plastic Modulus, Zy	=	1762.81	in^3
Torsional, J	=	37.237	in^4



Section Diagram

$$wt = 136.4 \div 144 \times 490 \times 1.2 = 557 \text{ plf} \quad \checkmark$$

Company : LHB
 Designer : jdf
 Job Number: 090147

Feb 2, 2010
 13:26 PM
 Checked By: CJM

5/12/10

Basic Properties of Shapes in Section: BR3A-4d (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	36.000 ✓	36.000 ✓	1.000 ✓	1.000 ✓
Height (in)	0.750 ✓	0.750 ✓	41.188	41.188
Xo (in)	0.000	0.000	-15.500 ✓	15.500 ✓
Yo (in)	20.969 ✓	-20.969 ✓	0.000	0.000
Ax (in^2)	27.000	27.000	41.188	41.188
Ixx (in^4)	1.266	1.266	5822.57	5822.57
Iyy (in^4)	2916.00	2916.00	3.432	3.432

Additional Properties of Shapes in Section: BR3A-4d (Local Axis, for n=1)

Sx-Top (in^3)	3.375	3.375	282.74	282.74
Sy-Right (in^3)	162.00	162.00	6.865	6.865
rx (in)	0.217	0.217	11.890	11.890
ry (in)	10.392	10.392	0.289	0.289
Zx (in^3)	5.063	5.063	424.10	424.10
Zy (in^3)	243.00	243.00	10.297	10.297
J (in^4)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

J-15

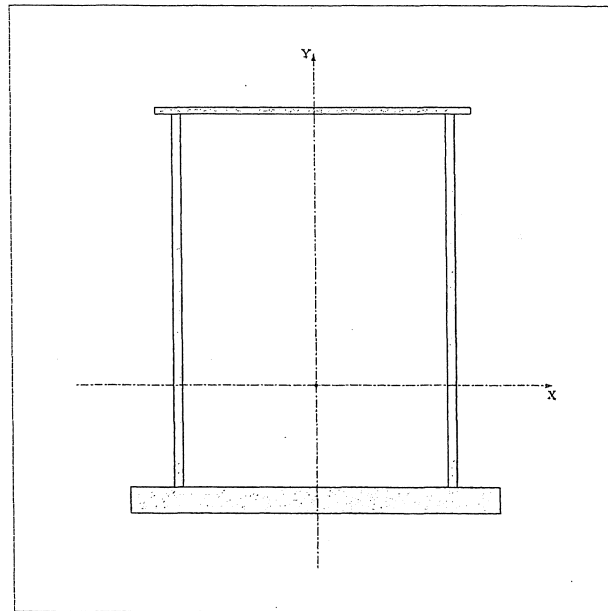
5113110

Section Properties: BR3A-4e

Number of Shapes	=	4	
Total Width	=	42.000	in ✓
Total Height	=	45.750	in ✓
Center, Xo	=	0.000	in
Center, Yo	=	-8.402	in
X-bar(Right)	=	21.000	in
X-bar(Left)	=	21.000	in
Y-bar(Top)	=	31.277	in
Y-bar(Bot)	=	14.473	in

Equivalent Properties:

Area, Ax	=	237.00	in^2
Inertia, Ixx	=	6.706E+004	in^4
Inertia, Iyy	=	4.163E+004	in^4
Inertia, Ixy	=	0.000	in^4
Modulus, Sx(Top)	=	2143.97	in^3
Modulus, Sx(Bot)	=	4633.20	in^3
Modulus, Sy(Left)	=	1982.19	in^3
Modulus, Sy(Right)	=	1982.19	in^3
Radius, rx	=	16.821	in
Radius, ry	=	13.253	in
Plastic Modulus, Zx	=	3095.79	in^3
Plastic Modulus, Zy	=	2868.00	in^3
Torsional, J	=	395.30	in^4



Section Diagram

$$wt = 237.0 \div 144 \times 490 \times 1.2 = 968 \text{ plf} \quad \checkmark$$

J-16

Company : LHB
 Designer : jdf
 Job Number: 090147

Feb 2, 2010
 13:26 PM
 Checked By: CJM

51310

Basic Properties of Shapes in Section: BR3A-4e (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	36.000 ✓	42.000 ✓	1.000 ✓	1.000 ✓
Height (in)	0.750 ✓	3.000 ✓	42.000 ✓	42.000 ✓
Xo (in)	0.000	0.000	-15.500 ✓	15.500 ✓
Yo (in)	22.500 ✓	-21.375 ✓	1.125 ✓	1.125 ✓
Ax (in^2)	27.000	126.00	42.000	42.000
Ixx (in^4)	1.266	94.500	6174.00	6174.00
Iyy (in^4)	2916.00	1.852E+004	3.500	3.500

Additional Properties of Shapes in Section: BR3A-4e (Local Axis, for n=1)

Sx-Top (in^3)	3.375	63.000	294.00	294.00
Sy-Right (in^3)	162.00	882.00	7.000	7.000
rx (in)	0.217	0.866	12.124	12.124
ry (in)	10.392	12.124	0.289	0.289
Zx (in^3)	5.063	94.500	441.00	441.00
Zy (in^3)	243.00	1323.00	10.500	10.500
J (in^4)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

J-17

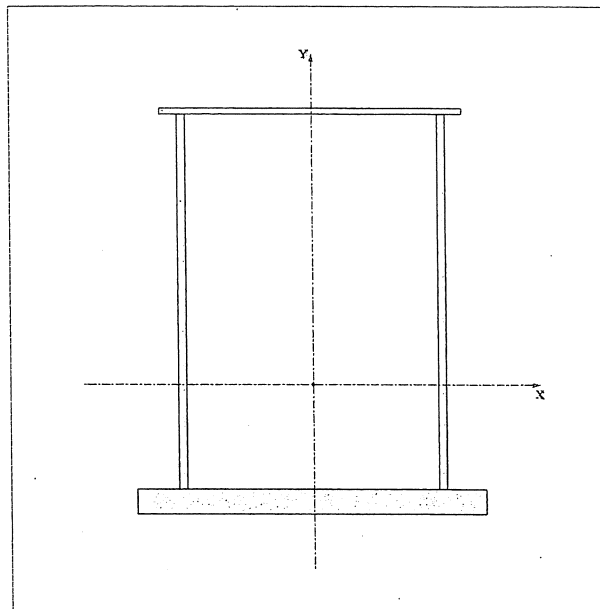
5/13/10

Section Properties: BR3A-4f

Number of Shapes	=	4	
Total Width	=	42.000	in ✓
Total Height	=	48.500	in ✓
Center, Xo	=	0.000	in
Center, Yo	=	-8.745	in
X-bar(Right)	=	21.000	in
X-bar(Left)	=	21.000	in
Y-bar(Top)	=	32.995	in
Y-bar(Bot)	=	15.505	in

Equivalent Properties:

Area, Ax	=	242.50	in^2
Inertia, Ixx	=	7.720E+004	in^4
Inertia, Iyy	=	4.295E+004	in^4
Inertia, Ixy	=	-0.000	in^4
Modulus, Sx(Top)	=	2339.80	in^3
Modulus, Sx(Bot)	=	4979.31	in^3
Modulus, Sy(Left)	=	2045.13	in^3
Modulus, Sy(Right)	=	2045.13	in^3
Radius, rx	=	17.843	in
Radius, ry	=	13.308	in
Plastic Modulus, Zx	=	3409.85	in^3
Plastic Modulus, Zy	=	2953.25	in^3
Torsional, J	=	397.39	in^4



Section Diagram

$$wt = 242.5 \div 144 \times 490 \times 1.2 = 990 \text{ plf} \checkmark$$

Company : LHB
 Designer : jdf
 Job Number: 090147

Feb 2, 2010
 13:26 PM
 Checked By: CJM

5/13/10

Basic Properties of Shapes in Section: BR3A-4f (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	36.000 ✓	42.000 ✓	1.000 ✓	1.000 ✓
Height (in)	0.750 ✓	3.000 ✓	44.750 ✓	44.750 ✓
Xo (in)	0.000	0.000	-15.500 ✓	15.500 ✓
Yo (in)	23.875 ✓	-22.750 ✓	1.130 ✓	1.130 ✓
Ax (in^2)	27.000	126.00	44.750	44.750
Ixx (in^4)	1.266	94.500	7467.89	7467.89
Iyy (in^4)	2916.00	1.852E+004	3.729	3.729

Additional Properties of Shapes in Section: BR3A-4f (Local Axis, for n=1)

Sx-Top (in^3)	3.375	63.000	333.76	333.76
Sy-Right (in^3)	162.00	882.00	7.458	7.458
rx (in)	0.217	0.866	12.918	12.918
ry (in)	10.392	12.124	0.289	0.289
Zx (in^3)	5.063	94.500	500.64	500.64
Zy (in^3)	243.00	1323.00	11.188	11.188
J (in^4)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

J-19

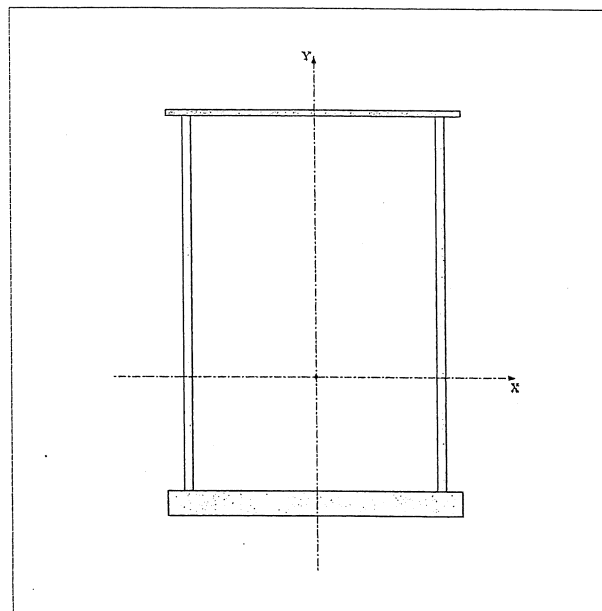
5/13/10

Section Properties: BR3A-4g

Number of Shapes	=	4	
Total Width	=	36.000	✓ in
Total Height	=	49.063	✓ in
Center, Xo	=	0.000	in
Center, Yo	=	-7.682	in
X-bar(Right)	=	18.000	in
X-bar(Left)	=	18.000	in
Y-bar(Top)	=	32.213	in
Y-bar(Bot)	=	16.849	in

Equivalent Properties:

Area, Ax	=	225.63	in^2
Inertia, Ixx	=	7.543E+004	in^4
Inertia, Iyy	=	3.636E+004	in^4
Inertia, Ixy	=	0.000	in^4
Modulus, Sx(Top)	=	2341.65	in^3
Modulus, Sx(Bot)	=	4476.80	in^3
Modulus, Sy(Left)	=	2020.01	in^3
Modulus, Sy(Right)	=	2020.01	in^3
Radius, rx	=	18.285	in
Radius, ry	=	12.695	in
Plastic Modulus, Zx	=	3437.21	in^3
Plastic Modulus, Zy	=	2619.69	in^3
Torsional, J	=	343.08	in^4



Section Diagram

$$wt = 225.6 \div 144 \times 490 \times 1.2 = 921 \text{ plf} \quad \checkmark$$

Company : LHB
 Designer : jdf
 Job Number: 090147

Feb 2, 2010
 13:26 PM
 Checked By: CJM

5/13/10

Basic Properties of Shapes in Section: BR3A-4g (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	36.000 ✓	36.000 ✓	1.000 ✓	1.000 ✓
Height (in)	0.750 ✓	3.000 ✓	45.313 ✓	45.313 ✓
Xo (in)	0.000	0.000	-15.500 ✓	15.500 ✓
Yo (in)	24.156 ✓	-23.031 ✓	1.125 ✓	1.125 ✓
Ax (in ²)	27.000	108.00	45.313	45.313
Ixx (in ⁴)	1.266	81.000	7753.05	7753.05
Iyy (in ⁴)	2916.00	1.166E+004	3.776	3.776

Additional Properties of Shapes in Section: BR3A-4g (Local Axis, for n=1)

Sx-Top (in ³)	3.375	54.000	342.20	342.20
Sy-Right (in ³)	162.00	648.00	7.552	7.552
rx (in)	0.217	0.866	13.081	13.081
ry (in)	10.392	10.392	0.289	0.289
Zx (in ³)	5.063	81.000	513.31	513.31
Zy (in ³)	243.00	972.00	11.328	11.328
J (in ⁴)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

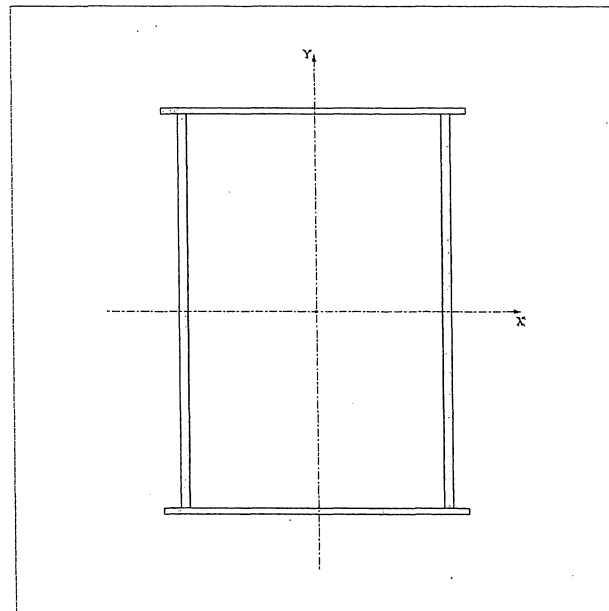
5/13/10

Section Properties: BR3A-4h

Number of Shapes	=	4	
Total Width	=	36.000	✓ in
Total Height	=	47.375	✓ in
Center, Xo	=	0.000	in
Center, Yo	=	0.000	in
X-bar(Right)	=	18.000	in
X-bar(Left)	=	18.000	in
Y-bar(Top)	=	23.688	in
Y-bar(Bot)	=	23.688	in

Equivalent Properties:

Area, Ax	=	145.75	in^2
Inertia, Ixx	=	4.544E+004	in^4
Inertia, Iyy	=	2.788E+004	in^4
Inertia, Ixy	=	0.000	in^4
Modulus, Sx(Top)	=	1918.35	in^3
Modulus, Sx(Bot)	=	1918.35	in^3
Modulus, Sy(Left)	=	1549.03	in^3
Modulus, Sy(Right)	=	1549.03	in^3
Radius, rx	=	17.657	in
Radius, ry	=	13.831	in
Plastic Modulus, Zx	=	2311.13	in^3
Plastic Modulus, Zy	=	1908.13	in^3
Torsional, J	=	40.377	in^4



Section Diagram

$$wt = 145.75 \div 144 \times 490 \times 1.2 = 595.0 \text{ plf} \quad \checkmark$$

Company : LHB
 Designer : jdf
 Job Number: 090147

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 13:26 PM
 Checked By: SJM

5/13/10

Basic Properties of Shapes in Section: BR3A-4h (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	36.000 ✓	36.000 ✓	1.000 ✓	1.000 ✓
Height (in)	0.750 ✓	0.750 ✓	45.875 ✓	45.875 ✓
Xo (in)	0.000	0.000	-15.500 ✓	15.500 ✓
Yo (in)	23.313 ✓	-23.313 ✓	0.000	0.000
Ax (in ²)	27.000	27.000	45.875	45.875
Ixx (in ⁴)	1.266	1.266	8045.39	8045.39
Iyy (in ⁴)	2916.00	2916.00	3.823	3.823

Additional Properties of Shapes in Section: BR3A-4h (Local Axis, for n=1)

Sx-Top (in ³)	3.375	3.375	350.75	350.75
Sy-Right (in ³)	162.00	162.00	7.646	7.646
rx (in)	0.217	0.217	13.243	13.243
ry (in)	10.392	10.392	0.289	0.289
Zx (in ³)	5.063	5.063	526.13	526.13
Zy (in ³)	243.00	243.00	11.469	11.469
J (in ⁴)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

J-23

Company : LHB
 Designer : jdf
 Job Number: 090147

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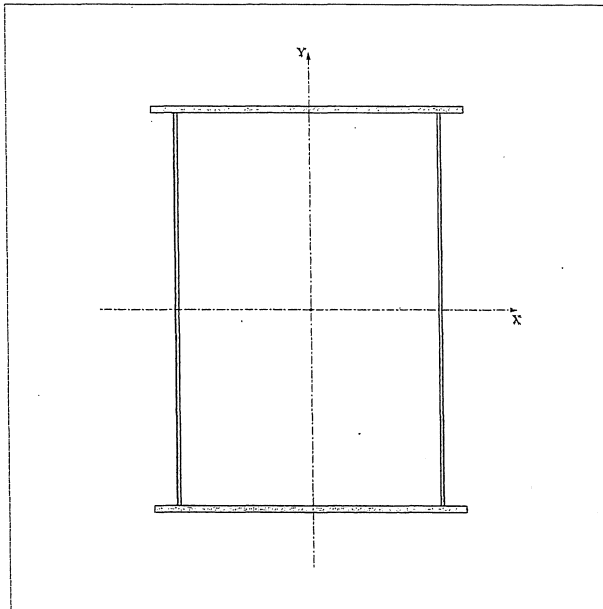
5/13/10

Section Properties: BR3A-4i

Number of Shapes	=	4	
Total Width	=	36.000	✓ in
Total Height	=	46.438	✓ in
Center, Xo	=	0.000	in
Center, Yo	=	0.000	in
X-bar(Right)	=	18.000	in
X-bar(Left)	=	18.000	in
Y-bar(Top)	=	23.219	in
Y-bar(Bot)	=	23.219	in

Equivalent Properties:

Area, Ax	=	87.703	in^2
Inertia, Ixx	=	3.385E+004	in^4
Inertia, Iyy	=	1.361E+004	in^4
Inertia, Ixy	=	0.000	in^4
Modulus, Sx(Top)	=	1458.02	in^3
Modulus, Sx(Bot)	=	1458.02	in^3
Modulus, Sy(Left)	=	755.91	in^3
Modulus, Sy(Right)	=	755.91	in^3
Radius, rx	=	19.647	in
Radius, ry	=	12.456	in
Plastic Modulus, Zx	=	1612.20	in^3
Plastic Modulus, Zy	=	997.87	in^3
Torsional, J	=	11.625	in^4



Section Diagram

$$wt = 87.7 \div 144 \times 490 \times 1.2 = 358 \text{ p/f} \quad \checkmark$$

Company : LHB
 Designer : jdf
 Job Number: 090147

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 13:26 PM
 Checked By: CJM

5/13/10

Basic Properties of Shapes in Section: BR3A-4i (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	36.000 ✓	36.000 ✓	0.375 ✓	0.375 ✓
Height (in)	0.750 ✓	0.750 ✓	44.938 ✓	44.938 ✓
Xo (in)	0.000	0.000	-15.188 ✓	15.188 ✓
Yo (in)	22.844 ✓	-22.844 ✓	0.000	0.000
Ax (in ²)	27.000	27.000	16.852	16.852
Ixx (in ⁴)	1.266	1.266	2835.81	2835.81
Iyy (in ⁴)	2916.00	2916.00	0.197	0.197

Additional Properties of Shapes in Section: BR3A-4i (Local Axis, for n=1)

Sx-Top (in ³)	3.375	3.375	126.21	126.21
Sy-Right (in ³)	162.00	162.00	1.053	1.053
rx (in)	0.217	0.217	12.972	12.972
ry (in)	10.392	10.392	0.108	0.108
Zx (in ³)	5.063	5.063	189.32	189.32
Zy (in ³)	243.00	243.00	1.580	1.580
J (in ⁴)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

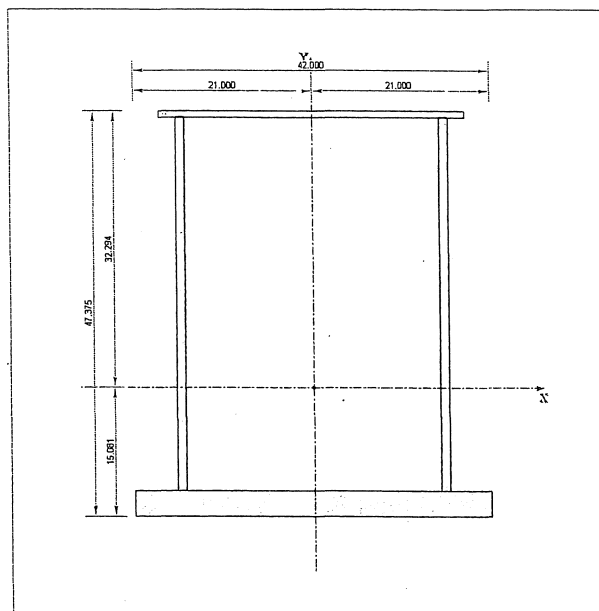
5/13/10

Section Properties: BR3A-4j

Number of Shapes	=	4	
Total Width	=	42.000	in ✓
Total Height	=	47.375	in ✓
Center, Xo	=	0.000	in
Center, Yo	=	-8.609	in
X-bar(Right)	=	21.000	in
X-bar(Left)	=	21.000	in
Y-bar(Top)	=	32.294	in
Y-bar(Bot)	=	15.081	in

Equivalent Properties:

Area, Ax	=	240.25	in^2
Inertia, Ixx	=	7.295E+004	in^4
Inertia, Iyy	=	4.241E+004	in^4
Inertia, Ixy	=	-0.000	in^4
Modulus, Sx(Top)	=	2258.85	in^3
Modulus, Sx(Bot)	=	4837.23	in^3
Modulus, Sy(Left)	=	2019.38	in^3
Modulus, Sy(Right)	=	2019.38	in^3
Radius, rx	=	17.425	in
Radius, ry	=	13.286	in
Plastic Modulus, Zx	=	3279.32	in^3
Plastic Modulus, Zy	=	2918.38	in^3
Torsional, J	=	396.09	in^4



Section Diagram

Company : LHB
 Designer : jdf
 Job Number: 090147

Feb 2, 2010
 13:26 PM
 Checked By: Gm

5/12/10

Basic Properties of Shapes in Section: BR3A-4j (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	36.000 ✓	42.000 ✓	1.000 ✓	1.000 ✓
Height (in)	0.750 ✓	3.000 ✓	43.625 ✓	43.625 ✓
Xo (in)	0.000	0.000	-15.500 ✓	15.500 ✓
Yo (in)	23.310 ✓	-22.190 ✓	1.125 ✓	1.125 ✓
Ax (in ²)	27.000	126.00	43.625	43.625
Ixx (in ⁴)	1.266	94.500	6918.71	6918.71
Iyy (in ⁴)	2916.00	1.852E+004	3.635	3.635

Additional Properties of Shapes in Section: BR3A-4j (Local Axis, for n=1)

Sx-Top (in ³)	3.375	63.000	317.19	317.19
Sy-Right (in ³)	162.00	882.00	7.271	7.271
rx (in)	0.217	0.866	12.593	12.593
ry (in)	10.392	12.124	0.289	0.289
Zx (in ³)	5.063	94.500	475.79	475.79
Zy (in ³)	243.00	1323.00	10.906	10.906
J (in ⁴)	0.000E+000	0.000E+000	0.000E+000	0.000E+000



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PROJECT MnDOT SS - 69801 3A-P4, Pinned or Fixed -1
PROJECT # 090147 DATE 11/9/09 BY jdf SHEET NO. 513110 OF

Are the beams fixed, pinned, or partially restrained to the pier cap. Is the pier cap fixed, or pinned to the pier?

Conc Pier to pier cap connection is made with a large number of anchor bolts suggesting a fixed pier cap to pier connection. ✓

The ^{interior} beams are connected to the pier cap by only web and bottom flange connections suggesting pinned beam to pier cap connection. ✓

The exterior beams are connected to the cap plate at the webs and by tie plates at the flanges. The Tie plates are 30"x1" and have lots of Bolts, suggesting possible fixed beam to pier cap connection. ✓

The Beam A calcs show matching DL moments on each side of the pier cap suggesting pinned beam to pier cap connection.

The pier cap calculations show a portion of the beam A moment being resisted by the pier cap, and a portion of the overall moment used for the column to pier cap connection.

∴ We have partial fixity for beam to pier cap and fully fixed for pier cap to pier. ✓



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PROJECT MnDOT SS-69801J 3A-P4, Pinned or Fixed - 2
PROJECT # 090147 DATE 2/19/10 BY jdF SHEET NO. _____ OF _____
✓ cm 5/13/10

We have 2 situations:

- 1) 2 Interior girders are pinned to cap ✓
- 2) 2 Exterior girders are "fixed" to cap ✓

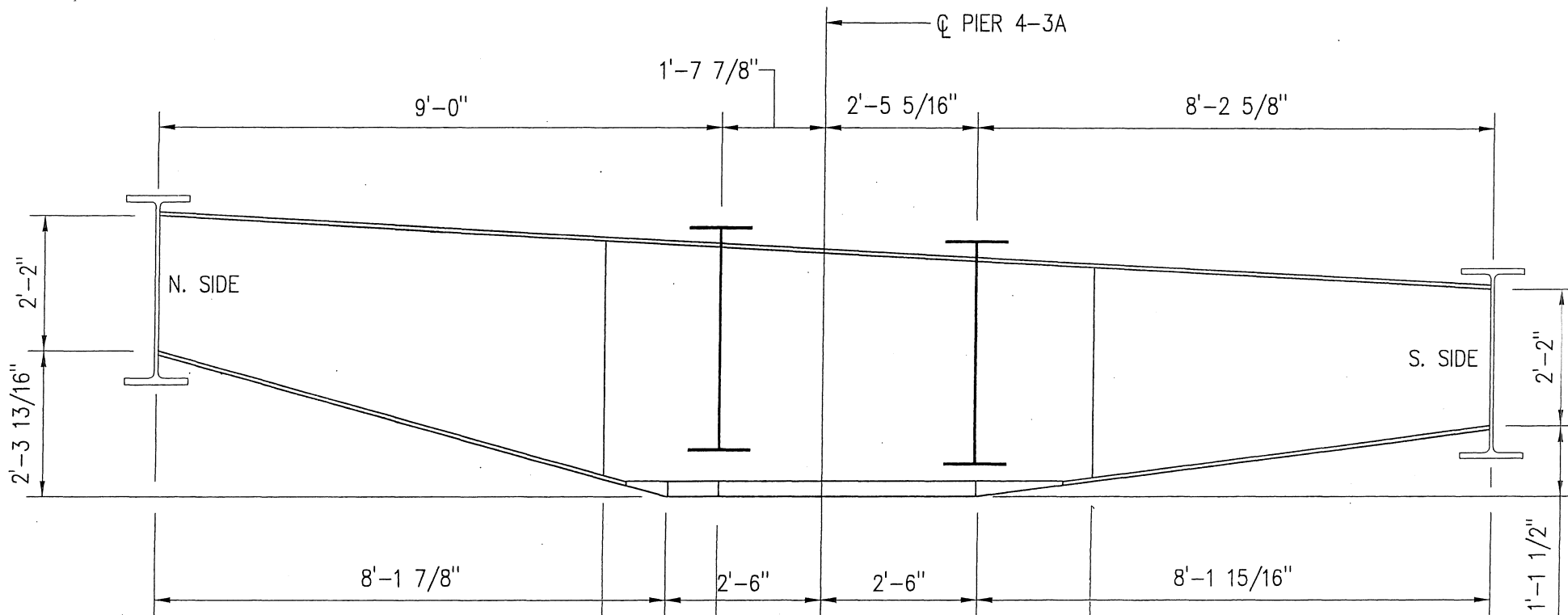
The pier cap is fixed to the top of concrete pier. ✓

How do we model this?

Interior Girders: Pinned. Torsion produced at top of pier connection for Longitudinal loads applied from Girder mid-depth to top of pier. ✓

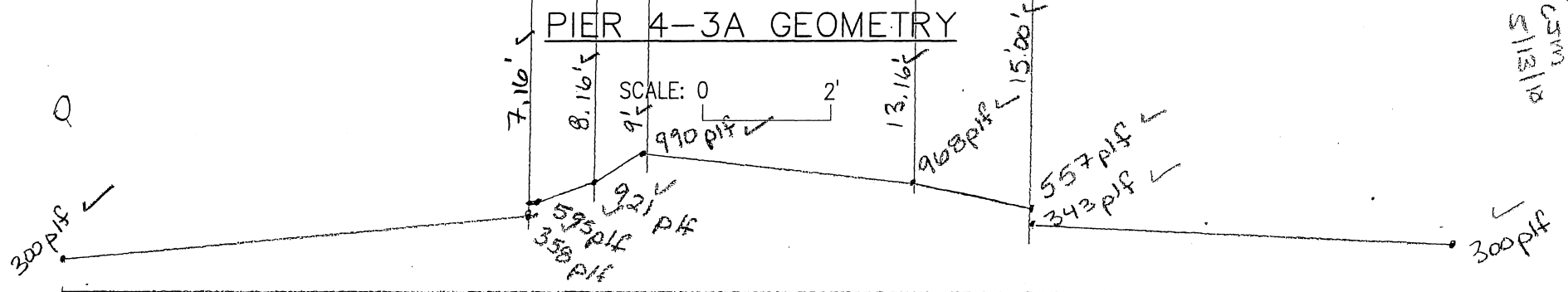
Exterior Girders: Fixed. Torsion produced from longitudinal loads from top of bridge deck down to top of pier. Therefore torsion is caused in pier cap along the way. ✓

Note that the truck location which causes the maximum Vertical Reaction does not cause maximum Rotation/torque. Therefore we must consider an additional load case. ✓



PIER 4-3A GEOMETRY

SCALE: 0 2'



08-1



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PROJECT MnDOT SS-69801 J - P4-3A - Non-comp DL Torque -1
PROJECT # 090147 DATE 2/16/10 BY jdf SHEET NO. 5 OF 13
VWS 5/13/10

Per MDX, the Non-composite Dead Load
"Flexural" Rotation for Girder 1 and Girder 7 @
Pier 4 is $-1.04 \text{ degrees} = 6.98 \times 10^{-4} \text{ Radians}$ ✓

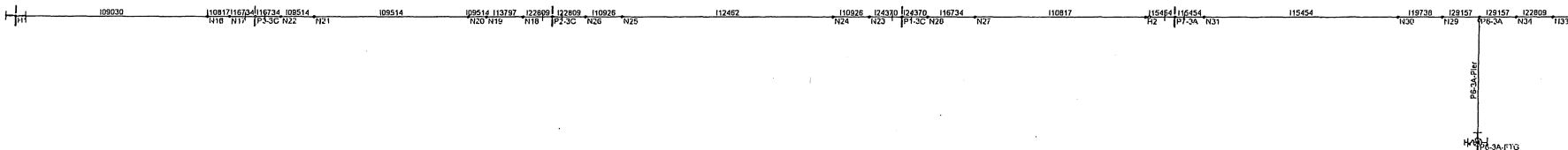
MDX models the girders w/ pinned supports.
Therefore we need to determine the
moment Req'd in the pinned model, to
create a Rotation of $6.98 \times 10^{-4} \text{ Radians}$
and then apply that moment to the
fixed model and use the portion
that goes to the pier. ✓

In pinned model, a 1 kip-ft moment creates
a Rotation of $4.126 \times 10^{-6} \text{ Radians}$.
Therefore the Moment is $6.98 \times 10^{-4} / 4.126 \times 10^{-6} =$
169 kip-ft. ✓

After we change the model to a spring support,
the Rotation Reduces to
 $4.804 \times 10^{-4} \text{ Radians}$, and the pier cap takes
52.6 kip-ft. ✓

Apply a DL torque of 52.6 kip-ft at Girders A
and F. (Non-comp Dead only). ✓

Y
ELx



LHB

jdf

090147

Pier 4,5,6-3A, Girder A and Beam A, Non-Comp Dead

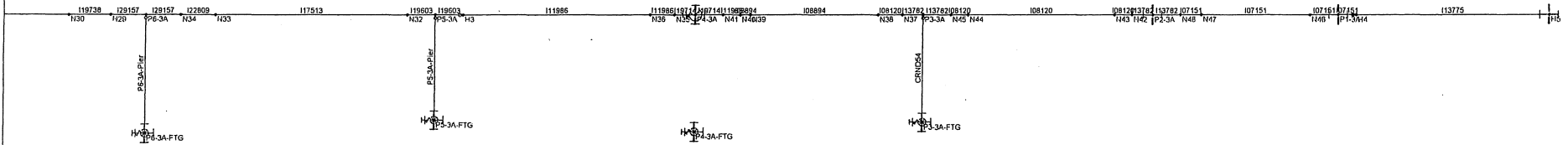
Shape Label

Mar 9, 2010 at 11:29 AM

090147_3A_P456_GirderABeamA_NonCompD...

5-32

Y
Z
X



LHB

jdf

090147

Pier 4,5,6-3A, Girder A and Beam A, Non-Comp Dead
Shape Label

Mar 9, 2010 at 11:30 AM

090147_3A_P456_GirderABeamA_NonCompD...

53-33

5/13/10

Global

Display Sections for Member Calcs	3
Max Internal Sections for Member Calcs	99
Include Shear Deformation	Yes
Include Warping	No
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Vertical Axis	Y

Hot Rolled Steel Code	AISC : ASD 13th
Cold Formed Steel Code	AISI 01: ASD
Wood Code	NDS 2005: ASD
Wood Temperature	< 100F
Concrete Code	ACI 2005
Masonry Code	MSJC 05/IBC 06 ASD

Number of Shear Regions	4
Region Spacing Increment (in)	4
Biaxial Column Method	Exact Integration
Parme Beta Factor (PCA)	.65
Concrete Stress Block	Rectangular
Use Cracked Sections	Yes
Bad Framing Warnings	No
Unused Force Warnings	Yes

Footing Overturning Safety Factor	1.5
Check Concrete Bearing	Yes
Self Wt, Overburden in DL for Design	Yes
Footing Concrete Weight	.145 k/ft^3
Footing Concrete f'c	3 ksi
Footing Concrete Ec	4000 ksi
Footing Steel fy	60 ksi
Minimum Steel	0.0018
Maximum Steel	0.0075
Footing Top Bar	#3
Footing Top Bar Cover	3.5 in
Footing Bottom Bar	#4
Footing Bottom Bar Cover	3.5 in
Pedestal Bar	#3
Pedestal Bar Cover	1.5 in
Pedestal Ties	#3

General Material Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (1/E5 F)	Density[k/ft^3]
1	gen Conc4NW	3644	1584	.15	.6	.145
2	gen Alum	10600	4077	.3	1.29	.173
3	gen Steel	29000	11154	.3	.65	.49
4	RIGID	1e+6		.3	0	0

Member Primary Data

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1-1	H1	N16			I09030	Beam	None	gen_Steel	Typical
2	M1-2	N16	N17			I10817	Beam	None	gen_Steel	Typical
3	M1-3	N17	P3-3C			I16734	Beam	None	gen_Steel	Typical
4	M2-1	P3-3C	N22			I16734	Beam	None	gen_Steel	Typical

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Non-Comp Dead

Mar 9, 2010
 11:30 AM
 Checked By: *CJM*

5/13/16

Member Primary Data (Continued) ✓

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
5	M2-2	N22	N21			I09514	Beam	None	gen_Steel	Typical
6	M2-3	N21	N20			I09514	Beam	None	gen_Steel	Typical
7	M2-4	N20	N19			I09514	Beam	None	gen_Steel	Typical
8	M2-5	N19	N18			I13797	Beam	None	gen_Steel	Typical
9	M2-6	N18	P2-3C			I22809	Beam	None	gen_Steel	Typical
10	M3-1	P2-3C	N26			I22809	Beam	None	gen_Steel	Typical
11	M3-2	N26	N25			I10926	Beam	None	gen_Steel	Typical
12	M3-3	N25	N24			I12462	Beam	None	gen_Steel	Typical
13	M3-4	N24	N23			I10926	Beam	None	gen_Steel	Typical
14	M3-5	N23	P1-3C			I24370	Beam	None	gen_Steel	Typical
15	M4-1	P1-3C	N28			I24370	Beam	None	gen_Steel	Typical
16	M4-2	N28	N27			I16734	Beam	None	gen_Steel	Typical
17	M4-3	N27	H2			I10817	Beam	None	gen_Steel	Typical
18	M5-1	H2	P7-3A			I15454	Beam	None	gen_Steel	Typical
19	M6-1	P7-3A	N31			I15454	Beam	None	gen_Steel	Typical
20	M6-2	N31	N30			I15454	Beam	None	gen_Steel	Typical
21	M6-3	N30	N29			I19738	Beam	None	gen_Steel	Typical
22	M6-4	N29	P6-3A			I29157	Beam	None	gen_Steel	Typical
23	M7-1	P6-3A	N34			I29157	Beam	None	gen_Steel	Typical
24	M7-2	N34	N33			I22809	Beam	None	gen_Steel	Typical
25	M7-3	N33	N32			I17513	Beam	None	gen_Steel	Typical
26	M7-4	N32	P5-3A			I19603	Beam	None	gen_Steel	Typical
27	M8-1	P5-3A	H3			I19603	Beam	None	gen_Steel	Typical
28	M9-1	H3	N36			I11986	Beam	None	gen_Steel	Typical
29	M9-2	N36	N35			I11986	Beam	None	gen_Steel	Typical
30	M9-3	N35	P4-3A			I19714	Beam	None	gen_Steel	Typical
31	M10-1	P4-3A	N41			I19714	Beam	None	gen_Steel	Typical
32	M10-2	N41	N40			I11986	Beam	None	gen_Steel	Typical
33	M10-3	N40	N39			I08894	Beam	None	gen_Steel	Typical
34	M10-4	N39	N38			I08894	Beam	None	gen_Steel	Typical
35	M10-5	N38	N37			I08120	Beam	None	gen_Steel	Typical
36	M10-6	N37	P3-3A			I13782	Beam	None	gen_Steel	Typical
37	M11-1	P3-3A	N45			I13782	Beam	None	gen_Steel	Typical
38	M11-2	N45	N44			I08120	Beam	None	gen_Steel	Typical
39	M11-3	N44	N43			I08120	Beam	None	gen_Steel	Typical
40	M11-4	N43	N42			I08120	Beam	None	gen_Steel	Typical
41	M11-5	N42	P2-3A			I13782	Beam	None	gen_Steel	Typical
42	M12-1	P2-3A	N48			I13782	Beam	None	gen_Steel	Typical
43	M12-2	N48	N47			I07151	Beam	None	gen_Steel	Typical
44	M12-3	N47	N46			I07151	Beam	None	gen_Steel	Typical
45	M12-4	N46	P1-3A			I07151	Beam	None	gen_Steel	Typical
46	M13-1	P1-3A	H4			I07151	Beam	None	gen_Steel	Typical
47	M14-1	H4	H5			I13775	Beam	None	gen_Steel	Typical
48	M4-3A-COL	P4-3A-FTG	P4-3A			CRND60	Column	None	Conc4000...	Typical
49	M3-3A-COL	P3-3A-FTG	P3-3A			CRND54	Column	None	Conc4000...	Typical
50	M6-3A-COL	P6-3A-FTG	P6-3A			P6-3A-Pier	Column	None	gen_Conc...	Typical
51	M5-3A-COL	P5-3A-FTG	P5-3A			P5-3A-Pier	Column	None	gen_Conc...	Typical

Member Advanced Data ✓

	Label	I Release	J Release	I Offset[in]	J Offset[in]	T/C Only	Physical	TOM	Inactive
1	M1-1						Yes		
2	M1-2						Yes		
3	M1-3						Yes		
4	M2-1						Yes		
5	M2-2						Yes		
6	M2-3						Yes		

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Non-Comp Dead

Mar 9, 2010
 11:30 AM
 Checked By: *COM*

5/13/10

Member Advanced Data (Continued) ✓

	Label	I Release	J Release	I Offset[in]	J Offset[in]	T/C Only	Physical	TOM	Inactive
7	M2-4						Yes		
8	M2-5						Yes		
9	M2-6						Yes		
10	M3-1						Yes		
11	M3-2						Yes		
12	M3-3						Yes		
13	M3-4						Yes		
14	M3-5						Yes		
15	M4-1						Yes		
16	M4-2						Yes		
17	M4-3						Yes		
18	M5-1	XOOOXX					Yes		
19	M6-1						Yes		
20	M6-2						Yes		
21	M6-3						Yes		
22	M6-4						Yes		
23	M7-1						Yes		
24	M7-2						Yes		
25	M7-3						Yes		
26	M7-4						Yes		
27	M8-1		XOOOXX				Yes		
28	M9-1						Yes		
29	M9-2						Yes		
30	M9-3						Yes		
31	M10-1						Yes		
32	M10-2						Yes		
33	M10-3						Yes		
34	M10-4						Yes		
35	M10-5						Yes		
36	M10-6						Yes		
37	M11-1						Yes		
38	M11-2						Yes		
39	M11-3						Yes		
40	M11-4						Yes		
41	M11-5						Yes		
42	M12-1						Yes		
43	M12-2						Yes		
44	M12-3						Yes		
45	M12-4						Yes		
46	M13-1		XOOOXX				Yes		
47	M14-1						Yes		
48	M4-3A-COL						Yes		Inactive
49	M3-3A-COL		BenPIN				Yes		
50	M6-3A-COL		BenPIN				Yes		
51	M5-3A-COL		BenPIN				Yes		

Joint Coordinates and Temperatures ✓

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
1	H1	0	0	0	0	
2	P3-3C	65.02	0	0	0	
3	P2-3C	146.04	0	0	0	
4	P1-3C	241.87	0	0	0	
5	H2	308.47	0	0	0	
6	P7-3A	316.47	0	0	0	
7	P6-3A	399.1	0	0	0	
8	P6-3A-FTG	399.1	-34.2	0	0	

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Joint Coordinates and Temperatures (Continued) ✓

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
9	P5-3A	482.07	0	0	0	
10	P5-3A-FTG	482.07	-30.42	0	0	
11	H3	490.07	0	0	0	
12	P4-3A	557.06	0	0	0	
13	P4-3A-FTG	557.06	-33.75	0	0	
14	P3-3A	622.94	0	0	0	
15	P3-3A-FTG	622.94	-31.04	0	0	
16	P2-3A	689.22	0	0	0	
17	P1-3A	742.42	0	0	0	
18	H5	802.8	0	0	0	
19	H4	747.56	0	0	0	
20	N16	52.02	0	0	0	
21	N17	58.02	0	0	0	
22	N18	138.04	0	0	0	
23	N19	128.04	0	0	0	
24	N20	123.04	0	0	0	
25	N21	81.02	0	0	0	
26	N22	72.02	0	0	0	
27	N23	232.87	0	0	0	
28	N24	222.87	0	0	0	
29	N25	165.04	0	0	0	
30	N26	155.04	0	0	0	
31	N27	261.87	0	0	0	
32	N28	248.87	0	0	0	
33	N29	389.1	0	0	0	
34	N30	377.1	0	0	0	
35	N31	324.47	0	0	0	
36	N32	474.07	0	0	0	
37	N33	419.1	0	0	0	
38	N34	409.1	0	0	0	
39	N35	551.06	0	0	0	
40	N36	544.06	0	0	0	
41	N37	616.94	0	0	0	
42	N38	609.94	0	0	0	
43	N39	573.06	0	0	0	
44	N40	570.06	0	0	0	
45	N41	565.06	0	0	0	
46	N42	683.22	0	0	0	
47	N43	678.22	0	0	0	
48	N44	635.94	0	0	0	
49	N45	630.94	0	0	0	
50	N46	734.42	0	0	0	
51	N47	703.22	0	0	0	
52	N48	697.22	0	0	0	

Toggle on and off

Joint Boundary Conditions ✓

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot [k-ft/rad]	Y Rot [k-ft/rad]	Z Rot [k-ft/rad]	Footing
1	H1	Reaction	Reaction	Reaction	Reaction			
2	P3-3C	Reaction	Reaction	Reaction	Reaction			
3	P2-3C	Reaction	Reaction	Reaction	Reaction			
4	P1-3C	Reaction	Reaction	Reaction	Reaction			
5	P7-3A	Reaction	Reaction	Reaction	Reaction			
6	P6-3A-FTG	S100.2	Reaction	Reaction	Reaction	Reaction	Reaction	
7	P5-3A-FTG	S221	Reaction	Reaction	Reaction	Reaction	Reaction	
8	P4-3A-FTG	S143.2	Reaction	Reaction	Reaction	Reaction	Reaction	
9	P4-3A	S64.5	Reaction	Reaction	Reaction	Reaction	S109398	

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Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Non-Comp Dead

Mar 9, 2010
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5/13/10

Joint Boundary Conditions (Continued)

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot [k-ft/rad]	Y Rot [k-ft/rad]	Z Rot [k-ft/rad]	Footing
10	P3-3A-FTG	S114.6	Reaction	Reaction	Reaction	Reaction	Reaction	
11	P2-3A		Reaction	Reaction	Reaction			
12	P1-3A		Reaction	Reaction	Reaction			
13	H5	Reaction	Reaction	Reaction	Reaction			

Joint Loads and Enforced Displacements (BLC 1 : P4-3A Reaction Influence)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft..
1	P4-3A	D	Y	1

Joint Loads and Enforced Displacements (BLC 2 : P5-3A Reaction Influence)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft..
1	P5-3A	D	Y	1

Joint Loads and Enforced Displacements (BLC 3 : P6-3A Reaction Influence)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft..
1	P6-3A	D	Y	1

Joint Loads and Enforced Displacements (BLC 4 : Model MDX Loads)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft..
1	P1-3A	L	Y	-145
2	P1-3C	L	Y	-18
3	P2-3A	L	Y	-145
4	P2-3C	L	Y	-18
5	P3-3A	L	Y	-145
6	P3-3C	L	Y	-165
7	P4-3A	L	Y	-1.215
8	P5-3A	L	Y	-1.48
9	P6-3A	L	Y	-2.99
10	P7-3A	L	Y	-18

Joint Loads and Enforced Displacements (BLC 5 : Unit Load at P4-3A) ✓

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft..
1	P4-3A	L	Mz	1

Member Point Loads (BLC 4 : Model MDX Loads)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M1-1	Y	-125	%60
2	M1-1	Y	-125	%90
3	M1-1	Y	-12	%30
4	M2-2	Y	-17	%75
5	M2-3	Y	-175	%75
6	M2-3	Y	-17	%35
7	M2-5	Y	-18	%15
8	M3-2	Y	-18	%85
9	M3-3	Y	-18	%50
10	M3-3	Y	-18	%75
11	M3-3	Y	-18	%25
12	M3-4	Y	-18	%20
13	M4-2	Y	-18	%70
14	M4-3	Y	-18	%28
15	M4-3	Y	-18	%65
16	M5-1	Y	-23	%10
17	M5-1	Y	-18	0

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Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Non-Comp Dead

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571310

Member Point Loads (BLC 4 : Model MDX Loads) (Continued) - NO BLC's used

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
18	M6-2	Y	-.18	%80
19	M6-2	Y	-.18	%48
20	M6-2	Y	-.18	%15
21	M6-3	Y	-.18	%40
22	M7-2	Y	-.18	6.53
23	M7-3	Y	-.18	46.36
24	M7-3	Y	-.18	29.74
25	M7-3	Y	-.18	13.14
26	M8-1	Y	-.145	%90
27	M9-1	Y	-.145	53.59
28	M9-1	Y	-.145	40.19
29	M9-1	Y	-.145	26.8
30	M9-1	Y	-.145	13.4
31	M9-1	Y	-.145	0
32	M10-4	Y	-.145	33.33
33	M10-4	Y	-.145	16.88
34	M10-4	Y	-.145	.44
35	M11-3	Y	-.145	20.14
36	M11-3	Y	-.145	3.56
37	M11-3	Y	-.145	36.71
38	M12-3	Y	-.145	3.74
39	M12-3	Y	-.145	21.47
40	M13-1	Y	-.145	%50
41	M14-1	Y	-.145	2
42	M14-1	Y	-.145	22.09
43	M14-1	Y	-.145	11.04
44	M14-1	Y	-.145	33.14
45	M14-1	Y	-.145	44.19
46	M14-1	Y	-.255	%100

Member Distributed Loads (BLC 4 : Model MDX Loads)

	Member Label	Direction	Start Magnitude[k/ft, d...]	End Magnitude[k/ft, d...]	Start Location[ft, %]	End Location[ft, %]
1	M1-1	Y	-.99	-.99	0	0
2	M1-2	Y	-.99	-.99	0	0
3	M1-3	Y	-1.04	-1.04	0	0
4	M2-1	Y	-1.04	-1.04	0	0
5	M2-2	Y	-.99	-.99	0	0
6	M2-3	Y	-1.01	-1.01	0	0
7	M2-4	Y	-1.02	-1.02	0	0
8	M2-5	Y	-1.05	-1.05	0	0
9	M2-6	Y	-1.11	-1.11	0	0
10	M3-1	Y	-1.11	-1.11	0	0
11	M3-2	Y	-1.03	-1.03	0	0
12	M3-3	Y	-1.05	-1.05	0	0
13	M3-4	Y	-1.03	-1.03	0	0
14	M3-5	Y	-1.12	-1.12	0	0
15	M4-1	Y	-1.12	-1.12	0	0
16	M4-2	Y	-1.07	-1.07	0	0
17	M4-3	Y	-1.03	-1.03	0	0
18	M5-1	Y	-1.07	-1.07	0	0
19	M6-1	Y	-1.07	-1.07	0	0
20	M6-2	Y	-1.07	-1.07	0	0
21	M6-3	Y	-1.09	-1.09	0	0
22	M6-4	Y	-1.16	-1.16	0	0
23	M7-1	Y	-1.16	-1.16	0	0
24	M7-2	Y	-1.15	-1.15	0	0

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Non-Comp Dead

Mar 9, 2010
 11:30 AM
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51310

Member Distributed Loads (BLC 4 : Model MDX Loads) (Continued)

	Member Label	Direction	Start Magnitude[k/ft.d...	End Magnitude[k/ft.d...	Start Location[ft.%]	End Location[ft.%]
25	M7-3	Y	-1.08	-1.08	0	0
26	M7-4	Y	-1.13	-1.13	0	0
27	M8-1	Y	-1.13	-1.11	0	0
28	M9-1	Y	-1.1	-1.1	0	0
29	M9-2	Y	-1.1	-1.1	0	0
30	M9-3	Y	-1.17	-1.17	0	0
31	M10-1	Y	-1.17	-1.17	0	0
32	M10-2	Y	-1.06	-1.06	0	0
33	M10-3	Y	-1.06	-1.06	0	0
34	M10-4	Y	-1.06	-1.06	0	0
35	M10-5	Y	-1.03	-1.03	0	0
36	M10-6	Y	-1.09	-1.09	0	0
37	M11-1	Y	-1.09	-1.09	0	0
38	M11-2	Y	-1.03	-1.03	0	0
39	M11-3	Y	-1.03	-1.03	0	0
40	M11-4	Y	-1.03	-1.03	0	0
41	M11-5	Y	-1.09	-1.09	0	0
42	M12-1	Y	-1.09	-1.09	0	0
43	M12-2	Y	-1.02	-1.02	0	0
44	M12-3	Y	-1.02	-1.02	0	0
45	M12-4	Y	-1.02	-1.02	0	0
46	M13-1	Y	-1.02	-1.02	0	0
47	M14-1	Y	-1.09	-1.09	0	0

Moving Loads

Tag	Pattern	Incremen...	Both Ways	1st Joint	2nd J...	3rd Jo...	4th Jo...	5th Jo...	6th Jo...	7th Jo...	8th Jo...	9th Jo...	10th J...
No Data to Print ...													

Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distributed Area (Me...	Surface (...)
1	P4-3A Reaction Influe...	None				1			
2	P5-3A Reaction Influe...	None				1			
3	P6-3A Reaction Influe...	None				1			
4	Model MDX Loads	None				10	46	47	
✓ 5	Unit Load at P4-3A	None				1			

Load Combinations

	Description	Sol...PD...	SR...	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor
1	P4-3A Influence			1	1										
2	P5-3A Influence			2	1										
3	P6-3A Influence			3	1										
4	Model MDX Loads			4	1										
✓ 5	Unit Load at P4-3A			5	1										
✓ 6	Rot Load at P4-3A	Yes		5	169										

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PROJECT MNDOT SS-69801 J - Pier 4 - 3A Non-Comp Dead

PROJECT # 090147 DATE 3/9/10 BY jdf SHEET NO. _____ OF _____

Load Combination 4 is an attempt to model Girder A and Beam A in order to get matching Rotation @ Pier 4 with MDX.

The Moment of Inertias are from MDX.

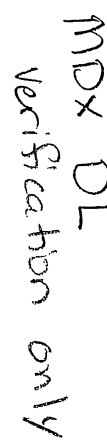
The Loads are from MDX.

- Non-composite dead loads (distributed loads)
- Bracing Loads (point loads)

In order to Compare w/ MDX, the MZ boundary condition must be deleted to model it as a pinned connection as MDX does.

This resulted in a Rotation of 0.05 degrees which is larger than the 0.04 degrees that MDX shows.

Per Jon Siiter, MDX also takes the neighboring beams into consideration for stiffness, so he feels it is OK for MDX to have less rotation than this Risa Model.



LHB
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090147

Pier 4,5,6-3A, Girder A and Beam A, Non-Comp Dead
BLC 4, Distributed Loads Only Shown

Mar 9, 2010 at 12:23 PM
090147_3A_P456_GirderABeamA_NonCompD...

J-42

MDX DL
Verification only

Loads: BLC 4, Model MDX Loads

LHB

jdf

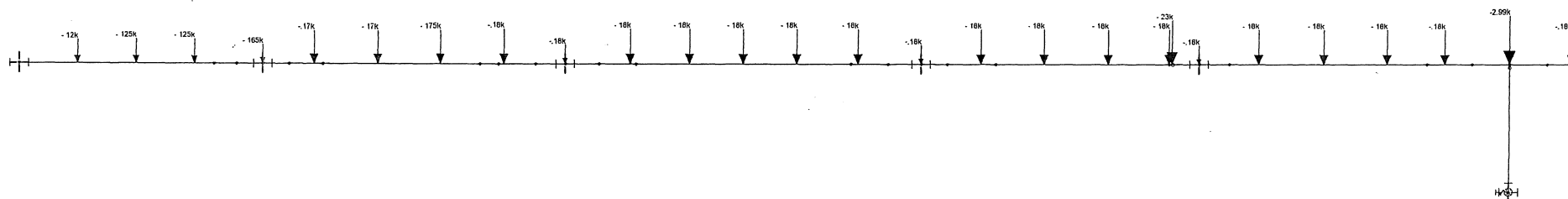
090147

Pier 4,5,6-3A, Girder A and Beam A, Non-Comp Dead
BLC4, Distributed Loads Only Shown

Mar 9, 2010 at 12:23 PM

090147_3A_P456_GirderABeamA_NonCompD...

J-43



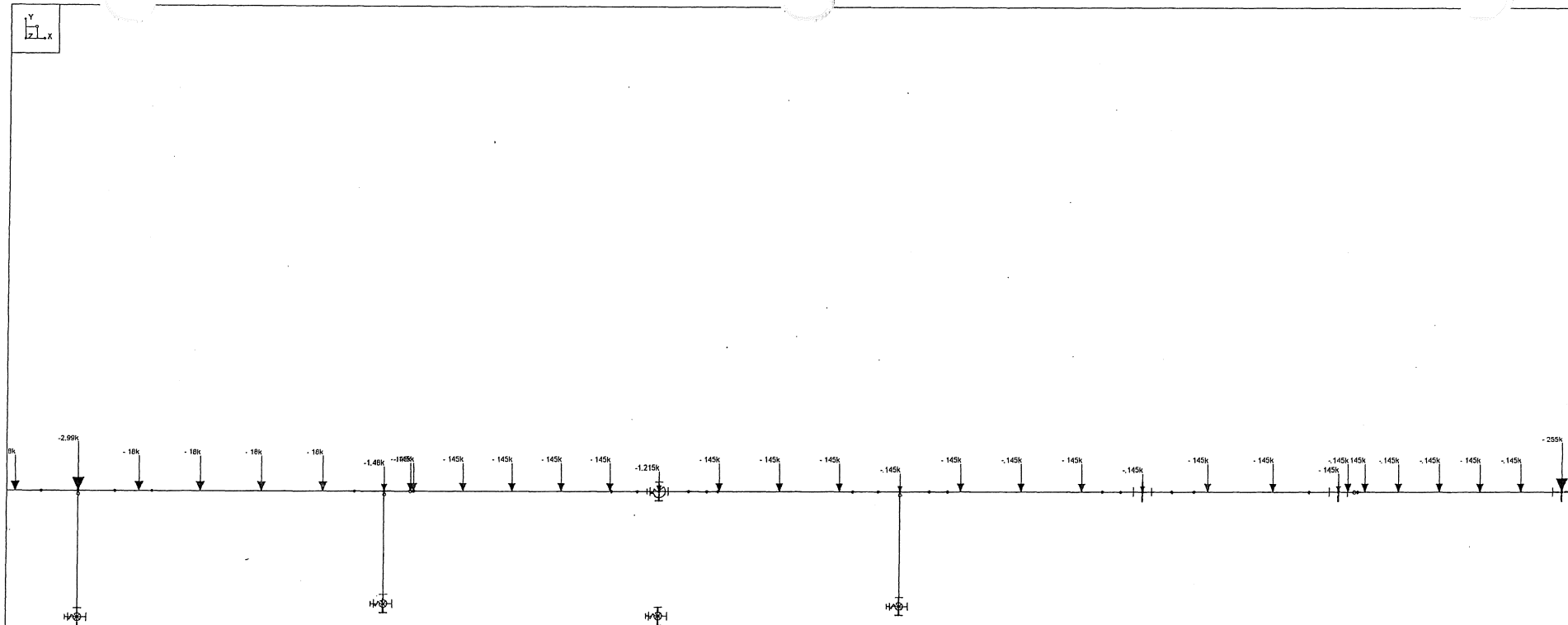
MDX DL
Verification only

LHB
jdf
090147

Pier 4,5,6-3A, Girder A and Beam A, Non-Comp Dead
BLC 4, Point and Joint Loads Only Shown

Mar 9, 2010 at 12:24 PM

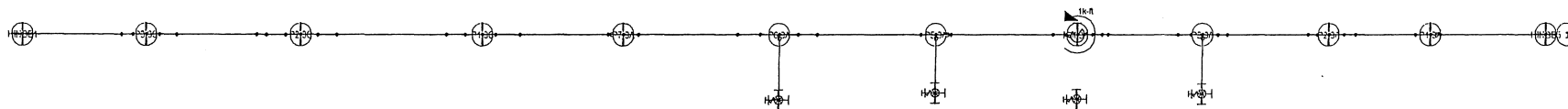
090147_3A_P456_GirderABeamA_NonCompD...



Loads: BLC 4, Model MDX Loads

090147_3A_P456_GirderABeamA_NonCompD...

Y
Z L X



UCSW
5/13/10

Loads: BLC5, Unit Load at P4-3A

LHB
jdf
090147

Pier 4,5,6-3A, Girder A and Beam A, Non-Comp Dead

Mar 9, 2010 at 12:25 PM

090147_3A_P456_GirderABeamA_NonCompD...

J46

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Non-Comp Dead

Mar 9, 2010
 11:28 AM
 Checked By: CJM

5/13/10

Joint Deflections (By Combination)

	LC	Joint Label	X [in]	Y [in]	Z [in]	X Rotation [rad]	Y Rotation [rad]	Z Rotation [rad]
1	6	H1	0	0	0	0	0	-2.879e-8
2	6	P3-3C	0	0	0	0	0	4.98e-8
3	6	P2-3C	0	0	0	0	0	-1.504e-7
4	6	P1-3C	0	0	0	0	0	5.311e-7
5	6	H2	0	0	0	0	0	1.189e-6
6	6	P7-3A	0	0	0	0	0	-7.77e-6
7	6	P6-3A	0	0	0	0	0	1.307e-5
8	6	P6-3A-FTG	0	0	0	0	0	0
9	6	P5-3A	0	0	0	0	0	-4.448e-5
10	6	P5-3A-FTG	0	0	0	0	0	0
11	6	H3	0	-.005	0	0	0	-2.51e-4
12	6	P4-3A	0	0	0	0	0	4.804e-4
13	6	P4-3A-FTG	0	0	0	0	0	0
14	6	P3-3A	0	0	0	0	0	-1.622e-4
15	6	P3-3A-FTG	0	0	0	0	0	0
16	6	P2-3A	0	0	0	0	0	4.883e-5
17	6	P1-3A	0	0	0	0	0	-2.879e-5
18	6	H5	0	0	0	0	0	2.679e-6
19	6	H4	0	-.002	0	0	0	2.679e-6
20	6	N16	0	0	0	0	0	2.835e-8
21	6	N17	0	0	0	0	0	3.999e-8
22	6	N18	0	0	0	0	0	-1.226e-7
23	6	N19	0	0	0	0	0	-7.404e-8
24	6	N20	0	0	0	0	0	-4.414e-8
25	6	N21	0	0	0	0	0	6.697e-8
26	6	N22	0	0	0	0	0	5.82e-8
27	6	N23	0	0	0	0	0	4.361e-7
28	6	N24	0	0	0	0	0	2.332e-7
29	6	N25	0	0	0	0	0	-2.065e-7
30	6	N26	0	0	0	0	0	-1.771e-7
31	6	N27	0	0	0	0	0	7.755e-7
32	6	N28	0	0	0	0	0	6.057e-7
33	6	N29	0	-.001	0	0	0	1.008e-5
34	6	N30	0	-.002	0	0	0	5.526e-6
35	6	N31	0	0	0	0	0	-7.553e-6
36	6	N32	0	.004	0	0	0	-3.165e-5
37	6	N33	0	.004	0	0	0	1.606e-5
38	6	N34	0	.002	0	0	0	1.538e-5
39	6	N35	0	-.031	0	0	0	3.988e-4
40	6	N36	0	-.059	0	0	0	2.582e-4
41	6	N37	0	.013	0	0	0	-1.904e-4
42	6	N38	0	.03	0	0	0	-2.137e-4
43	6	N39	0	.068	0	0	0	1.978e-4
44	6	N40	0	.059	0	0	0	2.7e-4
45	6	N41	0	.04	0	0	0	3.69e-4
46	6	N42	0	-.004	0	0	0	5.723e-5
47	6	N43	0	-.008	0	0	0	6.37e-5
48	6	N44	0	-.019	0	0	0	-7.837e-5
49	6	N45	0	-.013	0	0	0	-1.184e-4
50	6	N46	0	.003	0	0	0	-2.676e-5
51	6	N47	0	.006	0	0	0	1.986e-5
52	6	N48	0	.004	0	0	0	3.59e-5

Company : LHB
Designer : jdf
Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Non-Comp Dead

Mar 9, 2010
11:28 AM
Checked By: CTM

5/13/10

Joint Reactions (By Combination)

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	6	H1	0	0	0	0	0	0
2	6	P3-3C	0	0	0	0	0	0
3	6	P2-3C	0	.001	0	0	0	0
4	6	P1-3C	0	-.002	0	0	0	0
5	6	P7-3A	0	.024	0	0	0	0
6	6	P6-3A-FTG	0	-.127	0	0	0	0
7	6	P5-3A-FTG	0	.947	0	0	0	0
8	6	P4-3A-FTG	0	0	0	0	0	0
9	6	P4-3A	0	.317	0	0	0	-52.556
10	6	P3-3A-FTG	0	-1.482	0	0	0	0
11	6	P2-3A	0	.413	0	0	0	0
12	6	P1-3A	0	-.091	0	0	0	0
13	6	H5	0	0	0	0	0	0
14	6	Totals:	0	0	0			
15	6	COG (ft):	NC	NC	NC			



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PROJECT MnDOT SS-69801J-P4.3A-Superimposed DL Torque -1
PROJECT # 090147 DATE 2/19/10 BY jdf SHEET NO. OF

Per MDX, the Superimposed Dead Load "Flexural" Rotation for Girder 7 is -0.01° degrees and 0.00° degrees for Girder 1. (A)

$$.01 \text{ degree} = 1.745 \times 10^{-4} \text{ Radians} \checkmark$$

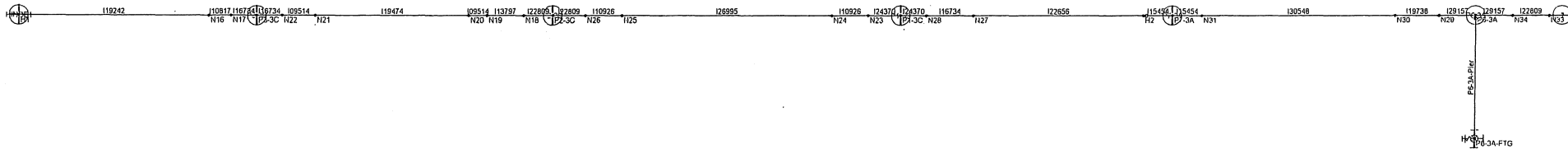
MDX models the girders w/ pinned supports. Therefore, we need to determine the moment required in the pinned model to create a rotation of 1.745×10^{-4} Radians, and then apply that moment to the fixed model and use the portion that goes to the pier.

In the pinned model, a 1 kip-ft moment creates a rotation of 3.16×10^{-6} Radians. Therefore the moment is $1.745 \times 10^{-4} / 3.16 \times 10^{-6} = 55.2$ kip-ft.

After we change the model to a spring support, the rotation reduces to 1.296×10^{-4} Radians, and the pier cap takes 14.2 kip-ft.

Apply a Superimposed DL torque of 14.2 kip-ft at Girder 7. (A)

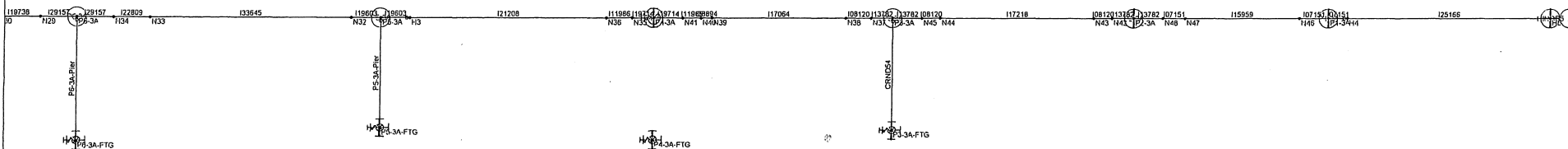
Y
Z
L_x



J-SD

LHB	Pier 4,5,6-3A, Girder A and Beam A, Superimposed Dead Loads	
jdf		Mar 9, 2010 at 1:26 PM
090147		090147_3A_P456_GirderABeamA_SuperimpD...

Y
LX



15-5

LHB	Pier 4,5,6-3A, Girder A and Beam A, Superimposed Dead Loads	
jdf		Mar 9, 2010 at 1:26 PM
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Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Superimposed Dead Loads

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5/13/10

Global

Display Sections for Member Calcs	3
Max Internal Sections for Member Calcs	99
Include Shear Deformation	Yes
Include Warping	No
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Vertical Axis	Y

Hot Rolled Steel Code	AISC : ASD 13th
Cold Formed Steel Code	AISI 01: ASD
Wood Code	NDS 2005: ASD
Wood Temperature	< 100F
Concrete Code	ACI 2005
Masonry Code	MSJC 05/IBC 06 ASD

Number of Shear Regions	4
Region Spacing Increment (in)	4
Biaxial Column Method	Exact Integration
Parame Beta Factor (PCA)	.65
Concrete Stress Block	Rectangular
Use Cracked Sections	Yes
Bad Framing Warnings	No
Unused Force Warnings	Yes

Footing Overturning Safety Factor	1.5
Check Concrete Bearing	Yes
Self Wt. Overburden in DL for Design	Yes
Footing Concrete Weight	.145 k/ft^3
Footing Concrete f _c	3 ksi
Footing Concrete E _c	4000 ksi
Footing Steel f _y	60 ksi
Minimum Steel	0.0018
Maximum Steel	0.0075
Footing Top Bar	#3
Footing Top Bar Cover	3.5 in
Footing Bottom Bar	#4
Footing Bottom Bar Cover	3.5 in
Pedestal Bar	#3
Pedestal Bar Cover	1.5 in
Pedestal Ties	#3

General Material Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (1/E5 F)	Density[k/ft^3]
1	gen Conc4NW	3644	1584	.15	.6	.145
2	gen Alum	10600	4077	.3	1.29	.173
3	gen Steel	29000	11154	.3	.65	.49
4	RIGID	1e+6		.3	0	0

Member Primary Data ✓

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1-1	H1	N16			I19242	Beam	None	gen_Steel	Typical
2	M1-2	N16	N17			I10817	Beam	None	gen_Steel	Typical
3	M1-3	N17	P3-3C			I16734	Beam	None	gen_Steel	Typical
4	M2-1	P3-3C	N22			I16734	Beam	None	gen_Steel	Typical

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Superimposed Dead Loads

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Member Primary Data (Continued) ✓

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
5	M2-2	N22	N21			I09514	Beam	None	gen_Steel	Typical
6	M2-3	N21	N20			I19474	Beam	None	gen_Steel	Typical
7	M2-4	N20	N19			I09514	Beam	None	gen_Steel	Typical
8	M2-5	N19	N18			I13797	Beam	None	gen_Steel	Typical
9	M2-6	N18	P2-3C			I22809	Beam	None	gen_Steel	Typical
10	M3-1	P2-3C	N26			I22809	Beam	None	gen_Steel	Typical
11	M3-2	N26	N25			I10926	Beam	None	gen_Steel	Typical
12	M3-3	N25	N24			I26995	Beam	None	gen_Steel	Typical
13	M3-4	N24	N23			I10926	Beam	None	gen_Steel	Typical
14	M3-5	N23	P1-3C			I24370	Beam	None	gen_Steel	Typical
15	M4-1	P1-3C	N28			I24370	Beam	None	gen_Steel	Typical
16	M4-2	N28	N27			I16734	Beam	None	gen_Steel	Typical
17	M4-3	N27	H2			I22656	Beam	None	gen_Steel	Typical
18	M5-1	H2	P7-3A			I15454	Beam	None	gen_Steel	Typical
19	M6-1	P7-3A	N31			I15454	Beam	None	gen_Steel	Typical
20	M6-2	N31	N30			I30548	Beam	None	gen_Steel	Typical
21	M6-3	N30	N29			I19738	Beam	None	gen_Steel	Typical
22	M6-4	N29	P6-3A			I29157	Beam	None	gen_Steel	Typical
23	M7-1	P6-3A	N34			I29157	Beam	None	gen_Steel	Typical
24	M7-2	N34	N33			I22809	Beam	None	gen_Steel	Typical
25	M7-3	N33	N32			I33645	Beam	None	gen_Steel	Typical
26	M7-4	N32	P5-3A			I19603	Beam	None	gen_Steel	Typical
27	M8-1	P5-3A	H3			I19603	Beam	None	gen_Steel	Typical
28	M9-1	H3	N36			I21208	Beam	None	gen_Steel	Typical
29	M9-2	N36	N35			I11986	Beam	None	gen_Steel	Typical
30	M9-3	N35	P4-3A			I19714	Beam	None	gen_Steel	Typical
31	M10-1	P4-3A	N41			I19714	Beam	None	gen_Steel	Typical
32	M10-2	N41	N40			I11986	Beam	None	gen_Steel	Typical
33	M10-3	N40	N39			I08894	Beam	None	gen_Steel	Typical
34	M10-4	N39	N38			I17064	Beam	None	gen_Steel	Typical
35	M10-5	N38	N37			I08120	Beam	None	gen_Steel	Typical
36	M10-6	N37	P3-3A			I13782	Beam	None	gen_Steel	Typical
37	M11-1	P3-3A	N45			I13782	Beam	None	gen_Steel	Typical
38	M11-2	N45	N44			I08120	Beam	None	gen_Steel	Typical
39	M11-3	N44	N43			I17218	Beam	None	gen_Steel	Typical
40	M11-4	N43	N42			I08120	Beam	None	gen_Steel	Typical
41	M11-5	N42	P2-3A			I13782	Beam	None	gen_Steel	Typical
42	M12-1	P2-3A	N48			I13782	Beam	None	gen_Steel	Typical
43	M12-2	N48	N47			I07151	Beam	None	gen_Steel	Typical
44	M12-3	N47	N46			I15959	Beam	None	gen_Steel	Typical
45	M12-4	N46	P1-3A			I07151	Beam	None	gen_Steel	Typical
46	M13-1	P1-3A	H4			I07151	Beam	None	gen_Steel	Typical
47	M14-1	H4	H5			I25166	Beam	None	gen_Steel	Typical
48	M4-3A-COL	P4-3A-FTG	P4-3A			CRND60	Column	None	Conc4000...	Typical
49	M3-3A-COL	P3-3A-FTG	P3-3A			CRND54	Column	None	Conc4000...	Typical
50	M6-3A-COL	P6-3A-FTG	P6-3A			P6-3A-Pier	Column	None	gen_Conc...	Typical
51	M5-3A-COL	P5-3A-FTG	P5-3A			P5-3A-Pier	Column	None	gen_Conc...	Typical

Member Advanced Data ✓

	Label	I Release	J Release	I Offset[in]	J Offset[in]	T/C Only	Physical	TOM	Inactive
1	M1-1						Yes		
2	M1-2						Yes		
3	M1-3						Yes		
4	M2-1						Yes		
5	M2-2						Yes		
6	M2-3						Yes		

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Superimposed Dead Loads

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Member Advanced Data (Continued)

	Label	I Release	J Release	I Offset[in]	J Offset[in]	T/C Only	Physical	TOM	Inactive
7	M2-4						Yes		
8	M2-5						Yes		
9	M2-6						Yes		
10	M3-1						Yes		
11	M3-2						Yes		
12	M3-3						Yes		
13	M3-4						Yes		
14	M3-5						Yes		
15	M4-1						Yes		
16	M4-2						Yes		
17	M4-3						Yes		
18	M5-1	XOOOXX ✓					Yes		
19	M6-1						Yes		
20	M6-2						Yes		
21	M6-3						Yes		
22	M6-4						Yes		
23	M7-1						Yes		
24	M7-2						Yes		
25	M7-3						Yes		
26	M7-4						Yes		
27	M8-1		XOOOXX ✓				Yes		
28	M9-1						Yes		
29	M9-2						Yes		
30	M9-3						Yes		
31	M10-1						Yes		
32	M10-2						Yes		
33	M10-3						Yes		
34	M10-4						Yes		
35	M10-5						Yes		
36	M10-6						Yes		
37	M11-1						Yes		
38	M11-2						Yes		
39	M11-3						Yes		
40	M11-4						Yes		
41	M11-5						Yes		
42	M12-1						Yes		
43	M12-2						Yes		
44	M12-3						Yes		
45	M12-4						Yes		
46	M13-1		XOOOXX ✓				Yes		
47	M14-1						Yes		
48	M4-3A-COL						Yes		Inactive
49	M3-3A-COL		BenPIN				Yes		
50	M6-3A-COL		BenPIN				Yes		
51	M5-3A-COL		BenPIN				Yes		

Joint Coordinates and Temperatures

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
1	H1	0	0	0	0	
2	P3-3C	65.02	0	0	0	
3	P2-3C	146.04	0	0	0	
4	P1-3C	241.87	0	0	0	
5	H2	308.47	0	0	0	
6	P7-3A	316.47	0	0	0	
7	P6-3A	399.1	0	0	0	
8	P6-3A-FTG	399.1	-34.2	0	0	

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Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Superimposed Dead Loads

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Joint Coordinates and Temperatures (Continued)

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
9	P5-3A	482.07	0	0	0	
10	P5-3A-FTG	482.07	-30.42	0	0	
11	H3	490.07	0	0	0	
12	P4-3A	557.06	0	0	0	
13	P4-3A-FTG	557.06	-33.75	0	0	
14	P3-3A	622.94	0	0	0	
15	P3-3A-FTG	622.94	-31.04	0	0	
16	P2-3A	689.22	0	0	0	
17	P1-3A	742.42	0	0	0	
18	H5	802.8	0	0	0	
19	H4	747.56	0	0	0	
20	N16	52.02	0	0	0	
21	N17	58.02	0	0	0	
22	N18	138.04	0	0	0	
23	N19	128.04	0	0	0	
24	N20	123.04	0	0	0	
25	N21	81.02	0	0	0	
26	N22	72.02	0	0	0	
27	N23	232.87	0	0	0	
28	N24	222.87	0	0	0	
29	N25	165.04	0	0	0	
30	N26	155.04	0	0	0	
31	N27	261.87	0	0	0	
32	N28	248.87	0	0	0	
33	N29	389.1	0	0	0	
34	N30	377.1	0	0	0	
35	N31	324.47	0	0	0	
36	N32	474.07	0	0	0	
37	N33	419.1	0	0	0	
38	N34	409.1	0	0	0	
39	N35	551.06	0	0	0	
40	N36	544.06	0	0	0	
41	N37	616.94	0	0	0	
42	N38	609.94	0	0	0	
43	N39	573.06	0	0	0	
44	N40	570.06	0	0	0	
45	N41	565.06	0	0	0	
46	N42	683.22	0	0	0	
47	N43	678.22	0	0	0	
48	N44	635.94	0	0	0	
49	N45	630.94	0	0	0	
50	N46	734.42	0	0	0	
51	N47	703.22	0	0	0	
52	N48	697.22	0	0	0	

Joint Boundary Conditions ✓

Toggle on and off

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot [k-ft/rad]	Y Rot [k-ft/rad]	Z Rot [k-ft/rad]	Footings
1	H1	Reaction	Reaction	Reaction	Reaction			
2	P3-3C	Reaction	Reaction	Reaction	Reaction			
3	P2-3C	Reaction	Reaction	Reaction	Reaction			
4	P1-3C	Reaction	Reaction	Reaction	Reaction			
5	P7-3A	Reaction	Reaction	Reaction	Reaction			
6	P6-3A-FTG	S100.2	Reaction	Reaction	Reaction	Reaction	Reaction	
7	P5-3A-FTG	S221	Reaction	Reaction	Reaction	Reaction	Reaction	
8	P4-3A-FTG	S143.2	Reaction	Reaction	Reaction	Reaction	Reaction	
9	P4-3A	S64.5	Reaction	Reaction	Reaction	Reaction	S109398	

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Joint Boundary Conditions (Continued)

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot.[k-ft/rad]	Y Rot.[k-ft/rad]	Z Rot.[k-ft/rad]	Footing
10	P3-3A-FTG	S114.6	Reaction	Reaction	Reaction	Reaction	Reaction	
11	P2-3A		Reaction	Reaction	Reaction			
12	P1-3A		Reaction	Reaction	Reaction			
13	H5	Reaction	Reaction	Reaction	Reaction			

Joint Loads and Enforced Displacements (BLC 1 : P4-3A Reaction Influence)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	P4-3A	D	Y	1

Joint Loads and Enforced Displacements (BLC 2 : P5-3A Reaction Influence)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	P5-3A	D	Y	1

Joint Loads and Enforced Displacements (BLC 3 : P6-3A Reaction Influence)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	P6-3A	D	Y	1

Joint Loads and Enforced Displacements (BLC 4 : Unit Rot Load at P4-3A)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	P4-3A	L	Mz	1

Member Point Loads

Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
No Data to Print ...			

Member Distributed Loads

Member Label	Direction	Start Magnitude[k/ft,d...]	End Magnitude[k/ft,d...]	Start Location[ft,%]	End Location[ft,%]
No Data to Print ...					

Moving Loads

Tag	Pattern	Incremen...	Both Ways	1st Joint	2nd J...	3rd Jo...	4th Jo...	5th Jo...	6th Jo...	7th Jo...	8th Jo...	9th Jo...	10th J...
No Data to Print ...													

Basic Load Cases

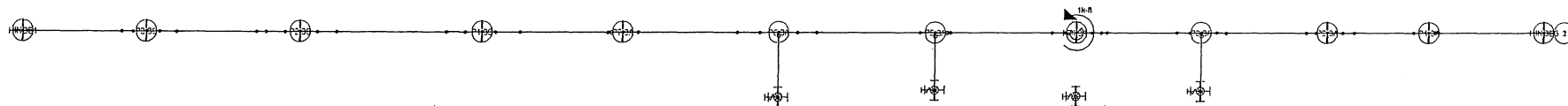
	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distributed Area (Me...	Surface (...]
1	P4-3A Reaction Influe...	None				1			
2	P5-3A Reaction Influe...	None				1			
3	P6-3A Reaction Influe...	None				1			
4	Unit Rot Load at P4-3A	None				1			

Load Combinations

	Description	Sol... PD... SR...	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor
1	P4-3A Influence		1	1									
2	P5-3A Influence		2	1									
3	P6-3A Influence		3	1									
4	Unit Rot Load at P4-3A		4	1									
5	Rot Load at P4-3A	Yes	4	55.2									

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ELx



Leads: BLC 4, Unit Rot Load at P4-3A

LHB
jdf
090147

Pier 4,5,6-3A, Girder A and Beam A, Superimposed Dead Loads

Mar 9, 2010 at 1:26 PM

090147_3A_P456_GirderABeamA_SuperimpD...

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51810

Company : LHB
Designer : jdf
Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Superimposed Dead Loads

Mar 9, 2010
2:53 PM
Checked By: WJM

5/13/10

Joint Deflections (By Combination)

	LC	Joint Label	X [in]	Y [in]	Z [in]	X Rotation [rad]	Y Rotation [rad]	Z Rotation [rad]
1	5	H1	0	0	0	0	0	0
2	5	P3-3C	0	0	0	0	0	0
3	5	P2-3C	0	0	0	0	0	-2.004e-8
4	5	P1-3C	0	0	0	0	0	8.676e-8
5	5	H2	0	0	0	0	0	1.825e-7
6	5	P7-3A	0	0	0	0	0	-1.267e-6
7	5	P6-3A	0	0	0	0	0	2.758e-6
8	5	P6-3A-FTG	0	0	0	0	0	0
9	5	P5-3A	0	0	0	0	0	-1.079e-5
10	5	P5-3A-FTG	0	0	0	0	0	0
11	5	H3	0	-.001	0	0	0	-5.416e-5
12	5	P4-3A	0	0	0	0	0	1.296e-4
13	5	P4-3A-FTG	0	0	0	0	0	0
14	5	P3-3A	0	0	0	0	0	-3.477e-5
15	5	P3-3A-FTG	0	0	0	0	0	0
16	5	P2-3A	0	0	0	0	0	8.211e-6
17	5	P1-3A	0	0	0	0	0	-3.705e-6
18	5	H5	0	0	0	0	0	3.448e-7
19	5	H4	0	0	0	0	0	3.448e-7
20	5	N16	0	0	0	0	0	0
21	5	N17	0	0	0	0	0	0
22	5	N18	0	0	0	0	0	-1.544e-8
23	5	N19	0	0	0	0	0	0
24	5	N20	0	0	0	0	0	0
25	5	N21	0	0	0	0	0	0
26	5	N22	0	0	0	0	0	0
27	5	N23	0	0	0	0	0	6.608e-8
28	5	N24	0	0	0	0	0	2.151e-8
29	5	N25	0	0	0	0	0	-2.717e-8
30	5	N26	0	0	0	0	0	-2.42e-8
31	5	N27	0	0	0	0	0	1.397e-7
32	5	N28	0	0	0	0	0	1.029e-7
33	5	N29	0	0	0	0	0	1.92e-6
34	5	N30	0	0	0	0	0	6.472e-7
35	5	N31	0	0	0	0	0	-1.205e-6
36	5	N32	0	0	0	0	0	-6.152e-6
37	5	N33	0	0	0	0	0	3.322e-6
38	5	N34	0	0	0	0	0	3.346e-6
39	5	N35	0	-.008	0	0	0	1.002e-4
40	5	N36	0	-.014	0	0	0	4.956e-5
41	5	N37	0	.003	0	0	0	-4.262e-5
42	5	N38	0	.007	0	0	0	-4.742e-5
43	5	N39	0	.016	0	0	0	3.151e-5
44	5	N40	0	.015	0	0	0	5.672e-5
45	5	N41	0	.01	0	0	0	9.111e-5
46	5	N42	0	0	0	0	0	1.004e-5
47	5	N43	0	-.001	0	0	0	1.113e-5
48	5	N44	0	-.004	0	0	0	-1.02e-5
49	5	N45	0	-.003	0	0	0	-2.198e-5
50	5	N46	0	0	0	0	0	-3.24e-6
51	5	N47	0	0	0	0	0	1.558e-6
52	5	N48	0	0	0	0	0	5.241e-6

J-58

Company : LHB
Designer : jdf
Job Number : 090147

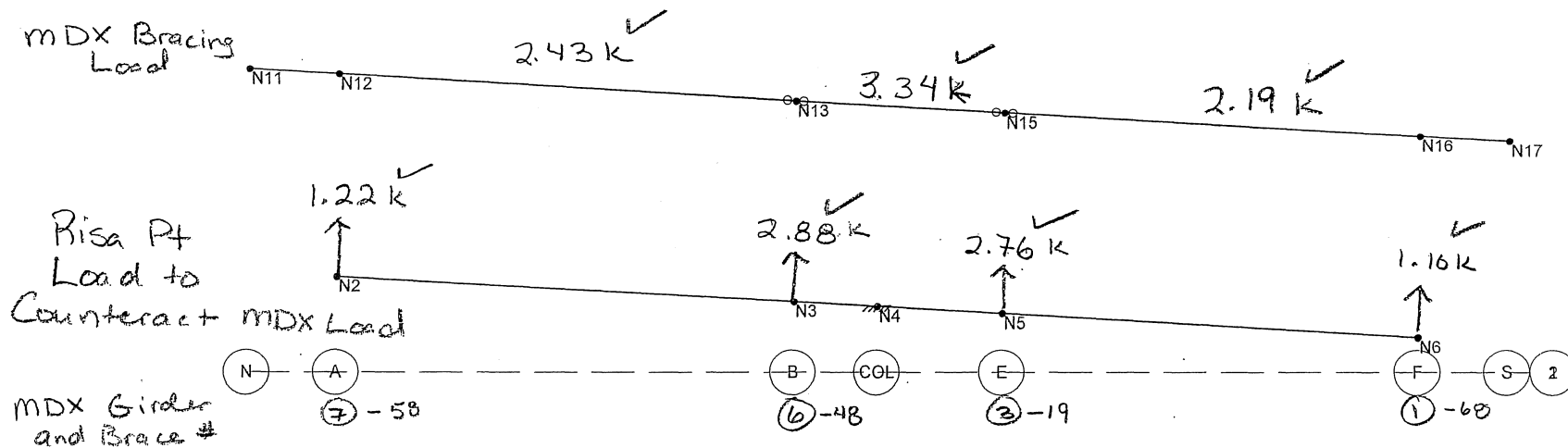
Pier 4,5,6-3A, Girder A and Beam A, Superimposed Dead Loads

Mar 9, 2010
2:53 PM
Checked By: *CJM*

5/13/10

Joint Reactions (By Combination)

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	5	H1	0	0	0	0	0	0
2	5	P3-3C	0	0	0	0	0	0
3	5	P2-3C	0	0	0	0	0	0
4	5	P1-3C	0	0	0	0	0	0
5	5	P7-3A	0	.007	0	0	0	0
6	5	P6-3A-FTG	0	-.042	0	0	0	0
7	5	P5-3A-FTG	0	.34	0	0	0	0
8	5	P4-3A-FTG	0	0	0	0	0	0
9	5	P4-3A	0	.082	0	0	0	-14.181
10	5	P3-3A-FTG	0	-.475	0	0	0	0
11	5	P2-3A	0	.11	0	0	0	0
12	5	P1-3A	0	-.021	0	0	0	0
13	5	H5	0	0	0	0	0	0
14	5	Totals:	0	0	0			
15	5	COG (ft):	NC	NC	NC			



1/CSM
5/13/10

LHB

jdf

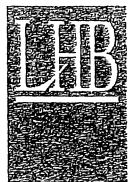
090147

Bridge 69801 3A Pier 4

MDX Bracing Loads

Jan 19, 2010 at 11:33 AM

090147_3A_P4.r3d



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PROJECT MnDOT SS-69801 - Centrifugal Forces - LRFD - 1
PROJECT # 090147 DATE 1/12/09 BY jaf SHEET NO. 5/4/10 OF 5/4/10

Determine Centrifugal forces on pier cap.
See 3.6.3

$$C = f \frac{v^2}{gR}$$

C = Factor to apply to axle weight of the design truck or tandem.

f = 4/3 for load comb. other than fatigue

v = Design speed (ft/sec)

g = 32.2 ft/sec²

R = Radius of curvature (ft).

P2-3E

S = 30 mph ✓ See JWS calcs 12-7-09 = 44 ft/sec

R = 254.25' ✓

$$C = \frac{4}{3} \times \frac{44^2}{32.2 \times 254.25} = \boxed{0.26}^{.32}$$

P4-3A

S = 40 mph = 58.7 ft/sec ✓

R = 473.7' ✓

$$\boxed{C = 0.30} \checkmark$$

P5-3A

S = 50 mph = 73.3 ft/sec ✓

R = 826.26' ✓

$$\boxed{C = 0.37} \checkmark$$

P6-3A

S = 50 mph = 73.3 ft/sec ✓

R = 826.26' ✓

$$\boxed{C = 0.27} \checkmark$$

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PROJECT MnDOT SS-69801J-PH-3A-Centrifugal Forces

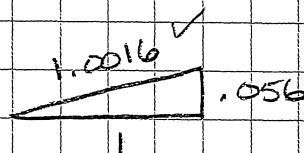
PROJECT # 090147 DATE 1/19/2010 BY jdf ^{✓com} _{5/13/10} SHEET NO. OF

$$S = 40 \text{ mph } \checkmark$$

$$R = 473.7' \checkmark$$

$$C = 0.30 \checkmark$$

$$\text{Superelevation} = 0.056 \text{ ft/ft } \checkmark$$



$$\text{CF balanced by Superelevation} = 0.30 - 0.056 = 0.244 \checkmark$$

$$\text{Controlling Reaction at pier} = \overset{\checkmark 2 \text{ lanes}}{2} \times \overset{\checkmark \text{ truck}}{69.7 \text{ k}} = 139.4 \text{ k}$$

$$\text{Total CF Load} = 0.244 \times 139.4 = 34.0 \text{ k } \checkmark$$

Distribute by "Pile group distribution"

I supports =>

N/A from Beam F: $\checkmark$

$$\frac{8.19 + 12.32 + 21.32}{4} = 10.46' \checkmark$$

$$I = 10.46^2 + (10.46 - 8.19)^2 + (12.32 - 10.46)^2 + (21.32 - 10.46)^2 \\ = 236.0 \text{ ft}^2$$

$$\begin{aligned} \text{Moment arm} &= 6' \times 1.0016 \\ &+ 0.67' \\ &+ 5' \\ &+ 2 \times 4.08' \\ &= 9.22' \end{aligned}$$

6' above slab
slab depth
bot slab to T/cap

$$P_{\downarrow} @ \text{ beam A} = 34.0 \text{ k} \times 9.22' \times (21.32 - 10.46) \div 236 = 14.43 \text{ k } \checkmark$$

$$P_{\downarrow} @ \text{ beam B} = 34.0 \text{ k} \times 9.22' \times (12.32 - 10.46) \div 236 = 2.47 \text{ k } \checkmark$$

$$P_{\downarrow} @ \text{ beams E \& F} = 0 \text{ kip as can't get uplift.}$$

$$P \leftarrow \text{at each beam @ g of cap beam} = \\ 34.0 \text{ k} \div 4 = 8.5 \text{ k } \checkmark$$

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PROJECT MnDOT-SS-69801J-P4-3A-Braking Force -1
PROJECT # 090147 DATE 1/22/2010 BY jdf SHEET NO. _____ OF _____
4/28/10

Determine Braking Force for Pier 4 of 3A.
Both Pier 4 and Pier 3 are fixed for these spans between expansion joints. Therefore we will need to approximate the relative stiffnesses of these piers to distribute the force accordingly. ✓

Determine total Braking Force to be shared by Pier 4 and Pier 3. ✓

Force is Greater of: (per Lane). ✓

- 1) 25% of axle weight of the design truck or design tandem. Since the single truck loading controls the strong axis bending we will use this loading here.

$$= .25 \times (8 + 32 + 32) = 18 \text{ kip} \checkmark \leftarrow \text{controls}$$

- 2) 5% of the design truck plus lane Load or 5% of the design tandem plus lane Load.

$$= 0.05 (8 + 32 + 32) + 0.05 \times .640 \times 258.6' = 11.9 \text{ kip}$$

★ Distance between expansion joints =
 $(66' - 11' \frac{5}{8}) + (65' - 10' \frac{1}{2}) + (22' - 3' \frac{1}{2}) + (43' - 11' \frac{7}{8}) + (53' - 2' \frac{3}{8}) + (6' - 1' \frac{5}{8}) = 258.6' \checkmark \leftarrow$

Conservative, but doesn't control anyway.

✓ - 2 lanes

$$\text{Total Braking Force} = 2 \times 18 \text{ k} = 36 \text{ kip} \checkmark$$

BR = 36 kip (split between piers 4 & 3.)

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PROJECT MnDOT-SS-69801J-P4-3A-Braking Force - 2

PROJECT # 090147 DATE 1/22/2010 BY jdF SHEET NO. _____ OF _____

arm
1/28/10

Pier 4 is the steel beam cap which is rigidly attached to the concrete pier.

Avg T/slab elev = $\frac{1}{2} \times (638.237 + 638.006) = 638.12$ ✓
Per orig. dwgs ↗ see sheet 137

T/slab now = $638.12 + 1.5" / (12") = 638.25'$ ✓
Added 1 1/2" when resurfaced.

Bottom of beam cap = $633.14'$ ✓ - sheet 86

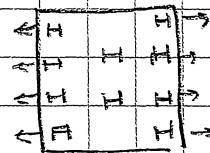
Top of conc. pier = $632.89'$ ✓

Top of ftg = $604.50'$ ✓ } sheet 53

Bottom of ftg = $600.50'$ ✓

Pier is a 5'-0" Ø pier ✓

Ftg is 15'x15'x4" w/ 10 piles. 125' deep. ✓
exterior 4 on each side battered. ← N.



T/slab to T/ftg = $33.75'$ ✓

See sheet 53



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PROJECT MnDOT-SS-69801J-P4-3A - Braking Force -3
PROJECT # 090147 DATE 1/22/2010 BY jdf SHEET NO. 1 OF 1
1/28/10

Pier 3 is a concrete "hammer" head

Avg T/slab elev = 634.42 per orig drawing sheet 137

T/slab now = $634.42 + 1.5/12\% = 634.54' \checkmark$

T/conc pier hammer = 630.24' $\checkmark$

B/conc hammer = 624.74' $\checkmark$

T/Ftg = 603.50' $\checkmark$

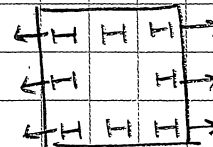
B/Ftg = 599.00' $\checkmark$

} sheet 52

Hammer is 3'-6" $\checkmark$ deep x 21'-2 1/2" $\checkmark$ wide

Pier is 4'-6" $\checkmark$ $\emptyset$ pier $\checkmark$

Ftg is 18' x 18' x 4'-6" w/ 8 piles, 125' $\checkmark$ deep.
Exterior two piles are battered.



T/slab to T/Ftg = 31.04' $\checkmark$

See sheet 52 $\checkmark$

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PROJECT Mn DOT - SS - 69801 J - P4 - 3A - Braking Force -4
PROJECT # 090147 DATE 1/22/2010 BY jd SHEET NO. _____ OF _____

✓ Com
Silt 3110

Pile classification:

12BP53 Pile,

- a) Restrained head
- b) long?
- c) fine grain soil

Use Figure 22 in the United States Steel Corporation's Highway Structures Design manual Volume I, Chapter 10.

need $\frac{\Delta_a k B D}{P_a} ; \beta B ; \frac{e}{D}$

Δ_a = displacement at ground surface (ft)

k = coefficient of horizontal subgrade reaction
 $= \frac{160 \bar{m} C}{B} \checkmark$

$\bar{m} \Rightarrow C$ = cohesion of fine-grained soil assume $c < 1 \text{ ksf}$
 and $\bar{m} = 0.32$

$\bar{m} = 0.32 \checkmark$

$C = .4 \text{ ksf}$ (assumed) (for soft clay)

B = section width of H-pile $\perp$ to loading (ft) = 1' $\checkmark$

$k = \frac{160 \times .32 \times .40}{1} = 20.48 \text{ ksf} \checkmark$

$B = 1' \checkmark$

D = length of pile embedment (ft) = 125' $\checkmark$

P_a = working lateral load (kips). Use 1 kip

$\frac{\Delta_a k B D}{P_a} = \frac{\Delta_a \times 20.48 \times 1' \times 125'}{P_a} = \frac{\Delta_a}{P_a} \times 2560 \checkmark$

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PROJECT MnDOT-SS-69801 J- P4-3A-Braking Force -5
PROJECT # 090147 DATE 1/22/2010 BY jdf SHEET NO. _____ OF _____

$$\beta_x = \frac{4 \sqrt{\frac{KB}{4EI}}} = \frac{4 \sqrt{\frac{20.48 \times 1'}{4 \times 4176000 \times 0.0190}}}{\sqrt{5/13/10}} = 0.090 \checkmark$$

$$E = 29000 \text{ ksi} = 4176000 \text{ k/ft}^2 \checkmark$$

$$I = 394.8 \text{ in}^4 = 0.0190 \text{ ft}^4 \checkmark$$

$$I_y = 127.3 \text{ in}^4 = 0.00614 \text{ ft}^4 \checkmark$$

$$\beta_y = \frac{4 \sqrt{\frac{20.48 \times 1'}{4 \times 4176000 \times 0.00614}}}{\sqrt{5/13/10}} = 0.119 \checkmark$$

↑ for Pier 3 & 4
in this direction

$$D = 125' \checkmark$$

ignore { e = height of line of action of lateral load above ground surface we will use above bot of ftg.

$$e_{p3} = (634.54 - 599.0) + 6' = 41.54'$$

$$e_{p4} = (638.25 - 600.5) + 6' = 43.75'$$

$$\frac{e}{D}_{p3} = \frac{41.54}{125} = 0.33$$

$$\frac{e}{D}_{p4} = \frac{43.75}{125} = 0.35$$

$$\beta D = 0.119 \times 125 = 14.9 \checkmark$$

Since Figure 22 for fixed heads, $\frac{e}{D}$ does not matter and βD , $\Delta_a k \beta D / P_a$ Ratio appears to be a 1 to 1 as it gets larger;

$$\therefore \frac{\Delta_a k \beta D}{P_a} \approx 14.9 = 2560 \frac{\Delta_a}{P_a} \checkmark$$

$$\Delta_a = \frac{14.9 \times P_a}{2560} = 0.00582 P_a \Rightarrow \frac{P_a}{\Delta_a} = 171.8 \text{ kip/ft} \checkmark$$

$$\therefore \text{if } P_a = 1 \text{ kip } \Delta_a = 0.00582 \checkmark$$

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PROJECT MnDOT-SS-69801J-P4-3A-Braking Force -6
PROJECT # 090147 DATE 1/22/2010 BY jdf ✓
SHEET NO. _____ OF _____

✓
✓_{CSM}
5/13/10

Spring factor for each pile cap?

P₃ has 8 piles $K = .00582 \div 8 = .000727 \text{ ft/kip}$ ✓

P₄ has 10 piles $K = .00582 \div 10 = .000582 \text{ ft/kip}$ ✓

$K_3 = \frac{1}{.000727} = 1376 \text{ kip/ft} = 114.6 \text{ kip/in}$ ✓

$K_4 = \frac{1}{.000582} = 1718 \text{ kip/ft} = 143.2 \text{ kip/in}$ ✓

Model the piers, & pile caps in Risa
and apply a 1 kip longitudinal force

P4-3A takes 62.4% ✓

P3-3A takes 37.6% ✓ of the 1 kip load.

Use these Percentages to apply Braking Force

P4-3A Braking Force = $.624 \times 36 \text{ k} = 22.5 \text{ kip}$ ✓

Bridge Deck width = 24.82' , $w = \frac{22.5 \text{ k}}{24.82'} = 0.907 \text{ k/ft}$ ✓

Torsion in piercap must be considered as
pier cap is rigidly attached to the concrete
column / pier.

Average moment arm: $.67' + .25' + .36' + \overbrace{[2.167 + \frac{1}{2}(2.32 + 1.125)]}^{\text{avg cap depth}} \div 2 = 3.22'$ ✓
↑ deck thickness ↑ haunch ↑ T/S to +1 cap

Moment = $3.22' \times .907 \text{ k/ft} = 2.92 \text{ kip.ft / ft}$ ✓

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PROJECT Mn DOT SS-69801J-P4-3A-Braking Force -7
PROJECT # 090147 DATE 2/17/10 BY jd SHEET NO. _____ OF _____
5/14/10

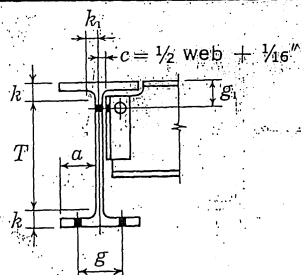
Only exterior girders will transmit torsion to pier cap. Determine proportion of load to these girders. Compare to Lateral Load Results.

Reaction @ Girder A due to 0.907 klf = 5.832 kip. ✓
" " Girder F " " " = 5.48 kip. ✓

Torque moment to apply @ A = $\left(\frac{5.832}{0.907}\right) \times 2.92 = 18.78 \text{ kip-ft}$ ✓
" " " " " F = $\left(\frac{5.48}{0.907}\right) \times 2.92 = 17.64 \text{ kip-ft}$

REGULAR SERIES

I

H BEARING PILES
Dimensions for detailing

Section Number & Nominal Size	Weight per Foot	Depth	Flange		Web		Distance						Usual Gage <i>g'</i>
			Width	Thick-ness	Thick-ness	Half Thick-ness	<i>a</i>	<i>T</i>	<i>k</i>	<i>k</i> ₁	<i>g</i> ₁	<i>c</i>	
In.	Lb.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
BP 14 14×14½	117	14¼	14⅞	1⅜ ₁₆	1⅜ ₁₆	⅞ ₁₆	7	11⅞	1⅜ ₁₆	1	2¾	½	5½
	102	14	14¾	1⅜ ₁₆	1⅜ ₁₆	⅞ ₁₆	7	11⅞	1⅜ ₁₆	1⅜ ₁₆	2¾	⅞ ₁₆	5½
	89	13⅞	14¾	⅞ ₈	⅞ ₈	⅝ ₁₆	7	11⅞	1¼	1⅜ ₁₆	2½	⅞ ₈	5½
	73	13⅝	14⅞	½	½	¼	7	11⅞	1⅞	⅞	2½	⅝ ₁₆	5½
BP 12 12×12	74	12⅞	12¼	⅞ ₈	⅞ ₈	⅝ ₁₆	5¾	9¾	1⅜ ₁₆	⅞ ₈	2½	⅞ ₈	5½
	53	11¾	12	⅞ ₁₆	⅞ ₁₆	¼	5¾	9¾	1	1⅜ ₁₆	2½	⅝ ₁₆	5½
BP 10 10×10	57	10	10¼	⅞ ₁₆	⅞ ₁₆	⅝ ₁₆	4⅞	7⅞	1⅜ ₁₆	1⅜ ₁₆	2½	⅞ ₈	5½
	42	9¾	10⅞	⅞ ₁₆	⅞ ₁₆	⅜ ₁₆	4⅞	7⅞	1⅜ ₁₆	1⅜ ₁₆	2½	¼	5½
BP 8 (8×8)	36	8	8⅞	⅞ ₁₆	⅞ ₁₆	¼	3⅞	6⅜	1⅜ ₁₆	⅞ ₈	2½	⅝ ₁₆	5½

ROLLED STEEL SHAPES

H BEARING PILES
Properties for designing

I

Weight per Foot	Area	Depth	Flange		Web Thick- ness	$\frac{d}{A_f}$	AXIS X-X			AXIS Y-Y		
			Width	Thick- ness			I	S	r	I	S	r
Lb.	In. ²	In.	In.	In.	In.		In. ⁴	In. ³	In.	In. ⁴	In. ³	In.
117	34.44	14.23	14.885	.805	.805	1.19	1228.5	172.6	5.97	443.1	59.5	3.59
102	30.01	14.03	14.784	.704	.704	1.35	1055.1	150.4	5.93	379.6	51.3	3.56
† 89	26.19	13.86	14.696	.616	.616	1.53	909.1	131.2	5.89	326.2	44.4	3.53
† 73	21.46	13.64	14.586	.506	.506	1.85	733.1	107.5	5.85	261.9	35.9	3.49
† 74	21.76	12.12	12.217	.607	.607	1.63	566.5	93.5	5.10	184.7	30.2	2.91
† 53	15.58	11.78	12.046	.436	.436	2.24	394.8	67.0	5.03	127.3	21.2	2.86
† 57	16.76	10.01	10.224	.564	.564	1.74	294.7	58.9	4.19	100.6	19.7	2.45
† 42	12.35	9.72	10.078	.418	.418	2.31	210.8	43.4	4.13	71.4	14.1	2.40
† 36	10.60	8.03	8.158	.446	.446	2.21	119.8	29.9	3.36	40.4	11.9	1.9

† Non-compact shape in A36, A242, A440 and A441.

Weight per Foot	Area	Depth	Flange		W
			Width	Average	
In.	In. ²	In.	In.	In.	In.
3.84	31.77	10.1	2.59	4.32	2.14
5.38	21.77	7.24	2.48	2.89	1.44
7.63	14.8	5.07	2.43	1.89	.96

Non-compact shape in A36, A242, A440 and A441.
Non-compact shape in A242, A440 and A441.



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PROJECT MnDOT SS - 69801 J - P4 - 3A - Load Distribution along Pier Cap
PROJECT # 090147 DATE 1/19/10 BY Jdf SHEET NO. _____ OF _____
✓
5/3/10

Loads to distribute:

Lane = 50.7 kip each lane ✓
divide over 10' width = $50.7 \text{ k} \div 10' = 5.07 \text{ klf}$
and 2.54 klf @ ends.

Truck = 69.7 k each lane ✓
divide over 2 tires = $69.7 \div 2 = 34.85 \text{ k}$ each

Distribute these loads as if the slab acts as
a simple span between interior beams
and the slab cantilevers over the top of
the exterior beam.

See Risa Loading Print-outs for Moment &
Shear Load Layouts.

Determine Load Combination Factors to Use in
Risa

Since 1.0 Lane + 1.0 Truck controls, and
impact only applies to the truck portion
of the Live Load,

Use 1.0 Lane + 1.33 Truck + 1.0 CF + 1.0 BR ✓



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PROJECT MnDOT SS-69801J-P4-3A - One Lane Loading

PROJECT # 090147 DATE 3/18/10 BY jdf SHEET NO. 51/3110 OF 51/3110

Check if one lane loading w/ a multiple presence factor, m , of 1.20 controls. See 3.6.1.1, 2.

Model the lane and truck loads out the farthest from the supports to both the Left and Right as possible. Compare these shears and moments to the 2-lane shears and moments.

Combine these loads as follows:

$$1.2 \text{ Lane} + \underbrace{1.33 \times 1.2}_{1.596 \checkmark} \text{ truck} + \underbrace{1.2 \times 0.5}_{0.6 \checkmark} (CF + BR)$$

After Reviewing the Shear and Moment Forces, One Lane Loading may control.

Review for each check.

For the Condition of maximum Torque w/ one lane use the following Load Combination, with max torque (lanes separate combination).

$$1.2 \text{ Lane} + \underbrace{1.33 \times 1.2}_{1.596 \checkmark} \text{ truck} + \underbrace{1.2 \times 0.5 \times 0.77}_{0.462 \checkmark} CF + \underbrace{1.2 \times 0.5}_{0.6 \checkmark} BR$$



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PROJECT MnDOT SS-69B01 J - P4-3A - Lane Loads

-1

PROJECT # 090147

DATE 2/16/10

BY jdf

SHEET NO. _____

OF _____

✓
5/14/10

Determine Loads causing Torque in Pier cap.

Some Lane Loading patterns will cause Rotation at pier 4. The interior girders will not transmit the Rotation to the pier cap due to their "pinned" connections.

The exterior girders will cause torque.

Torque to use for max Reaction Load case

$$T = 7.44 \text{ kip}\cdot\text{ft} \div 10' = 0.74 \text{ kip}\cdot\text{ft}/\text{ft}$$

w/ 0.37 kip·ft @ ends.

apply similar to lane loads as concentrated moments.

Only exterior girders transmit torsion to pier cap. Determine proportion of load to these girders.

Girder A

Girder F

$$\text{BLC 2: } 32.378/5.07 \times 0.74 = 4.73 \text{ kip}\cdot\text{ft} \quad 30.52/5.07 \times 0.74 = 4.45 \text{ kip}\cdot\text{ft}$$

$$\text{BLC 3: } 17.739/5.07 \times 0.74 = 2.59 \text{ kip}\cdot\text{ft} \quad 30.52/5.07 \times 0.74 = 4.45 \text{ kip}\cdot\text{ft}$$

$$\text{BLC 10: } (32.378/5.07) \times 0.74 = 4.73 \text{ kip}\cdot\text{ft} \quad (15.68/5.07) \times 0.74 = 2.29 \text{ kip}\cdot\text{ft}$$

$$\text{BLC 13: } (32.378/5.07) \times 0.74 = 4.73 \text{ kip}\cdot\text{ft} \quad = 0 \text{ kip}\cdot\text{ft}$$

J-73



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PROJECT MDOT SS-69801J-P4-3A - Trucks

-1

PROJECT # 090147

DATE 2/16/10

BY jdf
5/14/10

SHEET NO. _____ OF _____

Determine Loads causing Torque in Pier Cap.

Between the HL-93 Truck, Tandem, and 2 trucks @ 50' loadings, the HL-93 Truck causes the greatest vertical and torsional loadings in the pier cap. Therefore we will work with this loading.

The Torque at the maximum Reaction is $8.68 \checkmark \text{ kip}\cdot\text{ft} / \text{truck}$.

$\rightarrow 4.34 \checkmark \text{ kip}\cdot\text{ft} / \text{tire}$

apply similar to truck loads as concentrated moments.

Only exterior girders will transmit torsion to pier cap. Determine proportion of load to these girders. Compare to gravity Results.

	Girder A	Girder F
BLC 4	$(44.5 / 34.85) \times 4.34 = 5.54 \checkmark \text{ kip}\cdot\text{ft}$	$(41.91 / 34.85) \times 4.34 = 5.22 \checkmark \text{ kip}\cdot\text{ft}$
BLC 5	$15.23 / 34.85 \times 4.34 = 1.90 \text{ kip}\cdot\text{ft}$	$41.91 / 34.85 \times 4.34 = 5.22 \checkmark \text{ kip}\cdot\text{ft}$
BLC 6	$44.5 / 34.85 \times 4.34 = 5.54 \checkmark \text{ kip}\cdot\text{ft}$	$13.24 / 34.85 \times 4.34 = 1.65 \checkmark \text{ kip}\cdot\text{ft}$
BLC 11	$44.5 / 34.85 \times 4.34 = 5.54 \text{ kip}\cdot\text{ft}$	0 kip·ft.



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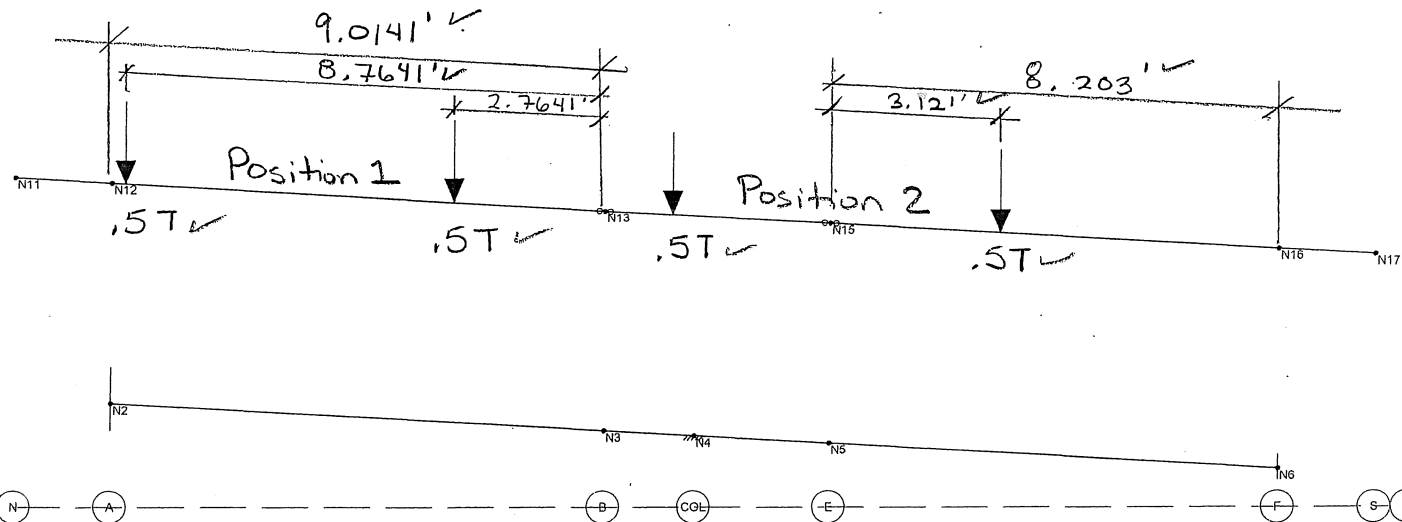
PROJECT MnDOT SS-69801 J-3A-P4 - Torsion to Girders A & F -1
PROJECT # 090147 DATE 4/16/10 BY jdf SHEET NO. _____ OF _____

Determine the Torque at Girders A & F caused by truck wheel loads as posited for permit & posting trucks.

Note the magnitude of the two trucks are different and therefore, we can't use the same ratio theory (similar to shear load) that we used for the HL-93 loading.

See the attached drawing for results.

J-75



$$\text{Girder A, Position 1} = .5T \times \frac{8.7641}{9.0141} + .5T \times \frac{2.7641}{9.0141} = 0.639 T$$

$$\text{Girder A, Position 2} = 0$$

$$\text{Girder F, Position 1} = 0$$

$$\text{Girder F, Position 2} = 0.5T \times \frac{3.121}{8.203} = 0.190 T$$

1/63M
5/14/10

Loads: BLC 6, Trucks Together L

LHB
jdf
090147

Bridge 69801 3A Pier 4
Torsion to Girders A & F

1
Apr 16, 2010 at 1:05 PM
090147_3A_P4_Pier.r3d



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PROJECT Mn DOT SS-69801 J - P4.3A - Max Torque Loads -1
PROJECT # 090147 DATE 2/23/10 BY jdf SHEET NO. 5114110 OF 5114110

The Reactions @ Pier 4 w/ max Torque are:

Lane Load: (per lane)

$$R = 23.7 \text{ kip} \checkmark$$

$$T = 92.1 \text{ kip}\cdot\text{ft} \checkmark$$

Truck: (per lane)

$$R = 53.7 \text{ kip} \checkmark$$

$$T = 171.0 \text{ kip}\cdot\text{ft}$$

Lane Loads:

Distribute R over 10'

$$W = 2.37 \text{ klf w/ } 1.18 \text{ klf at ends}$$

Distribute T over 10'

$$W = 9.21 \text{ kip}\cdot\text{ft}/\text{ft}$$

$$\text{Girder A gets: } 32.378 / 5.07 \times 9.21 = 58.8 \text{ kip}\cdot\text{ft} \checkmark$$

$$\text{Girder F gets: } 30.52 / 5.07 \times 9.21 = 55.4 \text{ kip}\cdot\text{ft} \checkmark$$

Truck Loads:

Distribute R over 2 tires

$$P = 53.7 / 2 = 26.9 \text{ kip}$$

Distribute T over 2 tires

$$T \text{ per tire} = 171.0 / 2 = 85.5 \text{ kip}\cdot\text{ft} \text{ 109.2 OK}$$

$$\text{Girder A gets: } (44.5 / 34.85) \times 85.5 = 106.1 \text{ kip}\cdot\text{ft}$$

$$\text{Girder F gets: } (41.9 / 34.85) \times 85.5 = 100.0 \text{ kip}\cdot\text{ft}$$

102.8 OK

Centrifugal Force:

$$\text{Truck Reaction @ Pier} = 2 \times 53.7 \text{ k} = 107.4 \text{ kip} \checkmark$$

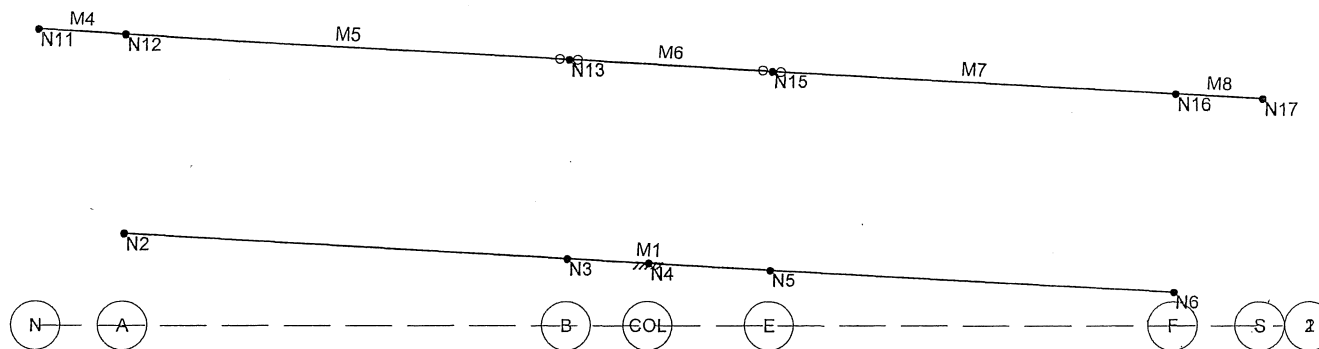
@ max Torque

$$\text{Truck Reaction @ Pier for max Reaction} = 2 \times 69.7 \text{ k} = 139.4 \text{ kip} \checkmark$$

$$\therefore \text{USE } 107.4 / 139.4 = 0.77 \text{ of the full CF forces.}$$

Braking Force: Same as Design Truck w/ max Reaction J-77

64000-3A-P4
MODEL INPUT



LHB

jdf

090147

Bridge 69801 3A Pier 4

Jan 19, 2010 at 3:56 PM

090147_3A_P4_Pier.r3d

Company : LHB
 Designer : jdf
 Job Number : 090147

Bridge 69801 3A Pier 4

Apr 26, 2010
 11:31 AM
 Checked By: *CTM*

5/14/10

Global

Display Sections for Member Calcs	2
Max Internal Sections for Member Calcs	200
Include Shear Deformation	Yes
Include Warping	No
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Vertical Axis	Y

Hot Rolled Steel Code	AISC : LRFD 13th
Cold Formed Steel Code	AISI 01: ASD
Wood Code	NDS 2005: ASD
Wood Temperature	< 100F
Concrete Code	ACI 2005
Masonry Code	MSJC 05/IBC 06 ASD

Number of Shear Regions	4
Region Spacing Increment (in)	4
Biaxial Column Method	Exact Integration
Parame Beta Factor (PCA)	.65
Concrete Stress Block	Rectangular
Use Cracked Sections	Yes
Bad Framing Warnings	No
Unused Force Warnings	Yes

Footing Overturning Safety Factor	1.5
Check Concrete Bearing	Yes
Self Wt, Overburden in DL for Design	Yes
Footing Concrete Weight	.145 k/ft^3
Footing Concrete f'c	3 ksi
Footing Concrete Ec	4000 ksi
Footing Steel fy	60 ksi
Minimum Steel	0.0018
Maximum Steel	0.0075
Footing Top Bar	#3
Footing Top Bar Cover	3.5 in
Footing Bottom Bar	#4
Footing Bottom Bar Cover	3.5 in
Pedestal Bar	#3
Pedestal Bar Cover	1.5 in
Pedestal Ties	#3

General Material Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (1/E5 F)	Density[k/ft^3]
1	A36 Steel	29000	11154	.3	.65	.49

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (1/E5 F)	Density[k/ft^3]	Yield[ksi]
1	A36	29000	11154	.3	.65	.49	36

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rules	A [in2]	Iyy [in4]	Izz [in4]	J [in4]
1	Slab	W8X40	Beam	None	A36	Typical	11.7	49.1	146	1.12

1C-2

5/14/10

Member Primary Data

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1	N2	N6			BR3A-4a-Rev...	Beam	None	A36 Steel	Default
2	M4	N11	N12			Slab	Beam	None	A36	Typical
3	M5	N12	N13			Slab	Beam	None	A36	Typical
4	M6	N13	N15			Slab	Beam	None	A36	Typical
5	M7	N15	N16			Slab	Beam	None	A36	Typical
6	M8	N16	N17			Slab	Beam	None	A36	Typical

Member Advanced Data

	Label	I Release	J Release	I Offset[in]	J Offset[in]	T/C Only	Physical	TOM	Inactive
1	M1						Yes	Yes	
2	M4						Yes	Yes	
3	M5		BenPIN				Yes	Yes	
4	M6	BenPIN	BenPIN				Yes	Yes	
5	M7	BenPIN					Yes	Yes	
6	M8						Yes	Yes	

Joint Coordinates and Temperatures

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
1	N2	1.75	1.902	0	0	
2	N3	10.75	1.398	0	0	
3	N4	12.41	1.305	0	0	
4	N5	14.88	1.167	0	0	
5	N6	23.07	.708	0	0	
6	N11	0	6	0	0	
7	N12	1.75	5.902	0	0	
8	N13	10.75	5.398	0	0	
9	N15	14.88	5.167	0	0	
10	N16	23.07	4.708	0	0	
11	N17	24.82	4.61	0	0	

Joint Boundary Conditions

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot.[k-ft/rad]	Y Rot.[k-ft/rad]	Z Rot.[k-ft/rad]	Footing
1	N4	Reaction	Reaction	Reaction	Reaction	Reaction	Reaction	
2	N12	SlaveN2	SlaveN2	SlaveN2	SlaveN2			
3	N13	SlaveN3	SlaveN3	SlaveN3	SlaveN3			
4	N15	SlaveN5	SlaveN5	SlaveN5	SlaveN5			
5	N16	SlaveN6	SlaveN6	SlaveN6	SlaveN6			

Joint Loads and Enforced Displacements (BLC 2 : Lanes Seperate)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft...]
1	N2	L	Mx	4.73
2	N6	L	Mx	4.45

Joint Loads and Enforced Displacements (BLC 3 : Lanes Together R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft...]
1	N2	L	Mx	2.59
2	N6	L	Mx	4.45

Joint Loads and Enforced Displacements (BLC 4 : Trucks Seperate)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft...]
--	-------------	-------	-----------	---

K-3

5/14/10

Joint Loads and Enforced Displacements (BLC 4 : Trucks Seperate) (Continued)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	5.54
2	N6	L	Mx	5.22

Joint Loads and Enforced Displacements (BLC 5 : Trucks Together R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	1.9
2	N6	L	Mx	5.22

Joint Loads and Enforced Displacements (BLC 6 : Trucks Together L)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	5.54
2	N6	L	Mx	1.65

Joint Loads and Enforced Displacements (BLC 7 : Centrifugal Force)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Y	-14.43
2	N3	L	Y	-2.47
3	N2	L	X	-8.5
4	N3	L	X	-8.5
5	N5	L	X	-8.5
6	N6	L	X	-8.5

Joint Loads and Enforced Displacements (BLC 8 : Noncomp Dead)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Y	-86.24
2	N3	L	Y	-66.62
3	N5	L	Y	-69.6
4	N6	L	Y	-77.79
5	N2	L	Mx	52.6
6	N6	L	Mx	52.6

Joint Loads and Enforced Displacements (BLC 9 : Superimposed Dead)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Y	-24.02
2	N3	L	Y	-22.66
3	N5	L	Y	-23.34
4	N6	L	Y	-24.05
5	N6	L	Mx	14.2

N2
5/21/10 *✓CSM 6/23/10*

Joint Loads and Enforced Displacements (BLC 10 : Lanes Together L)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	4.73
2	N6	L	Mx	2.29

Joint Loads and Enforced Displacements (BLC 11 : 1 Truck Left)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	5.54

Joint Loads and Enforced Displacements (BLC 12 : MDX Bracing Load)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Y	1.22
2	N3	L	Y	2.88
3	N5	L	Y	2.76
4	N6	L	Y	1.1

K-4

5/14/10

Joint Loads and Enforced Displacements (BLC 13 : 1 Lane Left)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	4.73

Joint Loads and Enforced Displacements (BLC 14 : Braking Force)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	18.78
2	N6	L	Mx	17.64

Joint Loads and Enforced Displacements (BLC 15 : Max Lane Torque)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	58.8
2	N6	L	Mx	55.4

Joint Loads and Enforced Displacements (BLC 16 : Max Truck Torque)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	106.1 <i>OK</i>
2	N6	L	Mx	100 <i>OK</i>

Joint Loads and Enforced Displacements (BLC 17 : Unit Torque at F)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N6	L	Mx	1

Joint Loads and Enforced Displacements (BLC 18 : 1 Truck Right)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N6	L	Mx	5.22

Joint Loads and Enforced Displacements (BLC 19 : 1 Lane Right)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N6	L	Mx	4.45

Joint Loads and Enforced Displacements (BLC 20 : Type 3 + SU7 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	5.68
2	N6	L	Mx	2.07

Joint Loads and Enforced Displacements (BLC 21 : Type 3S2-40 + SU7 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	5.68
2	N6	L	Mx	.46

Joint Loads and Enforced Displacements (BLC 22 : Type 3S3 + SU7 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	5.68
2	N6	L	Mx	1.7

Joint Loads and Enforced Displacements (BLC 23 : Std A + SU7 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	10.45
2	N6	L	Mx	1.69

Joint Loads and Enforced Displacements (BLC 24 : Std B + SU7 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	.64

K-S

5/14/10

Joint Loads and Enforced Displacements (BLC 24 : Std B + SU7 R) (Continued)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
2	N6	L	Mx	1.69

Joint Loads and Enforced Displacements (BLC 25 : Std C +SU7 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	2.67
2	N6	L	Mx	1.69

Joint Loads and Enforced Displacements (BLC 26 : P411 + SU7 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	23.76
2	N6	L	Mx	1.69

Joint Loads and Enforced Displacements (BLC 27 : P413 + SU7 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	22.64
2	N6	L	Mx	1.69

Joint Loads and Enforced Displacements (BLC 28 : Std C152b + SU7 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	3.65
2	N6	L	Mx	1.69

Joint Loads and Enforced Displacements (BLC 29 : Std C174b + SU7 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	5.97
2	N6	L	Mx	1.69

Joint Loads and Enforced Displacements (BLC 30 : Std C198 23 + SU7 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	.84
2	N6	L	Mx	1.69

Joint Loads and Enforced Displacements (BLC 31 : Std 214b + SU7 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	5.81
2	N6	L	Mx	1.69

Joint Loads and Enforced Displacements (BLC 32 : Std C237b + SU7 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	19.73
2	N6	L	Mx	1.69

Joint Loads and Enforced Displacements (BLC 33 : Std C256b + SU7 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	31.09
2	N6	L	Mx	1.69

Joint Loads and Enforced Displacements (BLC 34 : Std C200j + SU7 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	12.54
2	N6	L	Mx	1.69

K-6

5/14/10

Joint Loads and Enforced Displacements (BLC 35 : Type 3 + SU7 T)

	Joint Label	L,D,M	Direction	Magnitude[(k.k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	118.34
2	N6	L	Mx	22.49

Joint Loads and Enforced Displacements (BLC 36 : Type 3S2-40 + SU7 T)

	Joint Label	L,D,M	Direction	Magnitude[(k.k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	118.34
2	N6	L	Mx	27.27

Joint Loads and Enforced Displacements (BLC 37 : Type 3S3 + SU7 T)

	Joint Label	L,D,M	Direction	Magnitude[(k.k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	118.34
2	N6	L	Mx	29.17

Joint Loads and Enforced Displacements (BLC 38 : Std A + SU7 T)

	Joint Label	L,D,M	Direction	Magnitude[(k.k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	138.14
2	N6	L	Mx	35.19

Joint Loads and Enforced Displacements (BLC 39 : Std B + SU7 T)

	Joint Label	L,D,M	Direction	Magnitude[(k.k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	163.77
2	N6	L	Mx	35.19

Joint Loads and Enforced Displacements (BLC 40 : Std C +SU7 T)

	Joint Label	L,D,M	Direction	Magnitude[(k.k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	174.69
2	N6	L	Mx	35.19

Joint Loads and Enforced Displacements (BLC 41 : P411 + SU7 T)

	Joint Label	L,D,M	Direction	Magnitude[(k.k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	151.9
2	N6	L	Mx	35.19

Joint Loads and Enforced Displacements (BLC 42 : P413 + SU7 T)

	Joint Label	L,D,M	Direction	Magnitude[(k.k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	156.99
2	N6	L	Mx	35.19

Joint Loads and Enforced Displacements (BLC 43 : Std C152b + SU7 T)

	Joint Label	L,D,M	Direction	Magnitude[(k.k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	174.72
2	N6	L	Mx	35.19

Joint Loads and Enforced Displacements (BLC 44 : Std C174b + SU7 T)

	Joint Label	L,D,M	Direction	Magnitude[(k.k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	170.72
2	N6	L	Mx	35.19

Joint Loads and Enforced Displacements (BLC 45 : Std C198 23 + SU7 T)

	Joint Label	L,D,M	Direction	Magnitude[(k.k-ft), (in.rad), (k*s^2/ft..
1	N2	L	Mx	153.01
2	N6	L	Mx	35.19

K-7

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Joint Loads and Enforced Displacements (BLC 46 : Std 214b + SU7 T)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	153.31
2	N6	L	Mx	35.19

Joint Loads and Enforced Displacements (BLC 47 : Std C237b + SU7 T)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	155.55
2	N6	L	Mx	35.19

Joint Loads and Enforced Displacements (BLC 48 : Std C256b + SU7 T)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	160.91
2	N6	L	Mx	35.19

Joint Loads and Enforced Displacements (BLC 49 : Std C200j + SU7 T)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	169.93
2	N6	L	Mx	35.19

Joint Loads and Enforced Displacements (BLC 50 : Type 3 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	6.97

Joint Loads and Enforced Displacements (BLC 51 : Type 3S2-40 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	1.55

Joint Loads and Enforced Displacements (BLC 52 : Type 3S3 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	5.7

Joint Loads and Enforced Displacements (BLC 53 : Std A R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	10.45

Joint Loads and Enforced Displacements (BLC 54 : Std B R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	.64

Joint Loads and Enforced Displacements (BLC 55 : Std C R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	2.67

Joint Loads and Enforced Displacements (BLC 56 : P411 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	23.76

Joint Loads and Enforced Displacements (BLC 57 : P413 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	22.64

Joint Loads and Enforced Displacements (BLC 58 : Std C152b R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
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Joint Loads and Enforced Displacements (BLC 58 : Std C152b R) (Continued)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft...]
1	N2	L	Mx	3.65

Joint Loads and Enforced Displacements (BLC 59 : Std C174b R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft...]
1	N2	L	Mx	5.97

Joint Loads and Enforced Displacements (BLC 60 : Std C198 23 R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft...]
1	N2	L	Mx	.84

Joint Loads and Enforced Displacements (BLC 61 : Std 214b R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft...]
1	N2	L	Mx	5.81

Joint Loads and Enforced Displacements (BLC 62 : Std C237b R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft...]
1	N2	L	Mx	19.73

Joint Loads and Enforced Displacements (BLC 63 : Std C256b R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft...]
1	N2	L	Mx	31.09

Joint Loads and Enforced Displacements (BLC 64 : Std C200j R)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft...]
1	N2	L	Mx	12.54

Joint Loads and Enforced Displacements (BLC 65 : Type 3 T)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft...]
1	N2	L	Mx	75.63

Joint Loads and Enforced Displacements (BLC 66 : Type 3S2-40 T)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft...]
1	N2	L	Mx	91.72

Joint Loads and Enforced Displacements (BLC 67 : Type 3S3 T)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft...]
1	N2	L	Mx	98.12

Joint Loads and Enforced Displacements (BLC 68 : Std A T)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft...]
1	N2	L	Mx	138.14

Joint Loads and Enforced Displacements (BLC 69 : Std B T)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft...]
1	N2	L	Mx	163.77

Joint Loads and Enforced Displacements (BLC 70 : Std C T)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft...]
1	N2	L	Mx	174.69

Joint Loads and Enforced Displacements (BLC 71 : P411 T)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in,rad), (k*s^2/ft...]
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Joint Loads and Enforced Displacements (BLC 71 : P411 T) (Continued)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	151.9

Joint Loads and Enforced Displacements (BLC 72 : P413 T)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	156.99

Joint Loads and Enforced Displacements (BLC 73 : Std C152b T)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	174.72

Joint Loads and Enforced Displacements (BLC 74 : Std C174b T)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	170.72

Joint Loads and Enforced Displacements (BLC 75 : Std C198 23 T)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	153.01

Joint Loads and Enforced Displacements (BLC 76 : Std 214b T)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	153.31

Joint Loads and Enforced Displacements (BLC 77 : Std C237b T)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	155.55

Joint Loads and Enforced Displacements (BLC 78 : Std C256b T)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	160.91

Joint Loads and Enforced Displacements (BLC 79 : Std C200j T)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Mx	169.93

Member Point Loads (BLC 2 : Lanes Seperate)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M4	Y	-2.54	0
2	M4	Y	-5.07	1
3	M5	Y	-5.07	.25
4	M5	Y	-5.07	1.25
5	M5	Y	-5.07	2.25
6	M5	Y	-5.07	3.25
7	M5	Y	-5.07	4.25
8	M5	Y	-5.07	5.25
9	M5	Y	-5.07	6.25
10	M5	Y	-5.07	7.25
11	M5	Y	-2.54	8.25
12	M6	Y	-2.54	4.07
13	M7	Y	-5.07	.94
14	M7	Y	-5.07	1.94
15	M7	Y	-5.07	2.94
16	M7	Y	-5.07	3.94

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Member Point Loads (BLC 2 : Lanes Seperate) (Continued)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
17	M7	Y	-5.07	4.94
18	M7	Y	-5.07	5.94
19	M7	Y	-5.07	6.94
20	M7	Y	-5.07	7.94
21	M8	Y	-5.07	.75
22	M8	Y	-2.54	1.75

Member Point Loads (BLC 3 : Lanes Together R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-2.54	1.07
2	M5	Y	-5.07	2.07
3	M5	Y	-5.07	3.07
4	M5	Y	-5.07	4.07
5	M5	Y	-5.07	5.07
6	M5	Y	-5.07	6.07
7	M5	Y	-5.07	7.07
8	M5	Y	-5.07	8.07
9	M6	Y	-5.07	.07
10	M6	Y	-5.07	1.07
11	M6	Y	-2.54	2.07
12	M6	Y	-2.54	4.07
13	M7	Y	-5.07	.94
14	M7	Y	-5.07	1.94
15	M7	Y	-5.07	2.94
16	M7	Y	-5.07	3.94
17	M7	Y	-5.07	4.94
18	M7	Y	-5.07	5.94
19	M7	Y	-5.07	6.94
20	M7	Y	-5.07	7.94
21	M8	Y	-5.07	.75
22	M8	Y	-2.54	1.75

Member Point Loads (BLC 4 : Trucks Seperate)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-34.85	.25
2	M5	Y	-34.85	6.25
3	M7	Y	-34.85	1.94
4	M7	Y	-34.85	7.94

Member Point Loads (BLC 5 : Trucks Together R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-34.85	5.07
2	M6	Y	-34.85	2.07
3	M7	Y	-34.85	1.94
4	M7	Y	-34.85	7.94

Member Point Loads (BLC 6 : Trucks Together L)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-34.85	.25
2	M5	Y	-34.85	6.25
3	M6	Y	-34.85	1.25
4	M7	Y	-34.85	3.12

Member Point Loads (BLC 10 : Lanes Together L)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
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Member Point Loads (BLC 10 : Lanes Together L) (Continued)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M4	Y	-2.54	0
2	M4	Y	-5.07	1
3	M5	Y	-5.07	.25
4	M5	Y	-5.07	1.25
5	M5	Y	-5.07	2.25
6	M5	Y	-5.07	3.25
7	M5	Y	-5.07	4.25
8	M5	Y	-5.07	5.25
9	M5	Y	-5.07	6.25
10	M5	Y	-5.07	7.25
11	M5	Y	-2.54	8.25
12	M6	Y	-2.54	1.25
13	M6	Y	-5.07	2.25
14	M6	Y	-5.07	3.25
15	M7	Y	-5.07	.12
16	M7	Y	-5.07	1.12
17	M7	Y	-5.07	2.12
18	M7	Y	-5.07	3.12
19	M7	Y	-5.07	4.12
20	M7	Y	-5.07	5.12
21	M7	Y	-5.07	6.12
22	M7	Y	-2.54	7.12

Member Point Loads (BLC 11 : 1 Truck Left)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M5	Y	-34.85	.25
2	M5	Y	-34.85	6.25

Member Point Loads (BLC 13 : 1 Lane Left)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M4	Y	-2.54	0
2	M4	Y	-5.07	1
3	M5	Y	-5.07	.25
4	M5	Y	-5.07	1.25
5	M5	Y	-5.07	2.25
6	M5	Y	-5.07	3.25
7	M5	Y	-5.07	4.25
8	M5	Y	-5.07	5.25
9	M5	Y	-5.07	6.25
10	M5	Y	-5.07	7.25
11	M5	Y	-2.54	8.25

Member Point Loads (BLC 15 : Max Lane Torque)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M4	Y	-1.18	0
2	M4	Y	-2.37	1
3	M5	Y	-2.37	.25
4	M5	Y	-2.37	1.25
5	M5	Y	-2.37	2.25
6	M5	Y	-2.37	3.25
7	M5	Y	-2.37	4.25
8	M5	Y	-2.37	5.25
9	M5	Y	-2.37	6.25
10	M5	Y	-2.37	7.25
11	M5	Y	-1.18	8.25
12	M6	Y	-1.18	4.07

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Member Point Loads (BLC 15 : Max Lane Torque) (Continued)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
13	M7	Y	-2.37	.94
14	M7	Y	-2.37	1.94
15	M7	Y	-2.37	2.94
16	M7	Y	-2.37	3.94
17	M7	Y	-2.37	4.94
18	M7	Y	-2.37	5.94
19	M7	Y	-2.37	6.94
20	M7	Y	-2.37	7.94
21	M8	Y	-2.37	.75
22	M8	Y	-1.18	1.75

Member Point Loads (BLC 16 : Max Truck Torque)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M5	Y	-26.9	.25
2	M5	Y	-26.9	6.25
3	M7	Y	-26.9	1.94
4	M7	Y	-26.9	7.94

Member Point Loads (BLC 18 : 1 Truck Right)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M7	Y	-34.85	1.94
2	M7	Y	-34.85	7.94

Member Point Loads (BLC 19 : 1 Lane Right)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M6	Y	-2.54	4.07
2	M7	Y	-5.07	.94
3	M7	Y	-5.07	1.94
4	M7	Y	-5.07	2.94
5	M7	Y	-5.07	3.94
6	M7	Y	-5.07	4.94
7	M7	Y	-5.07	5.94
8	M7	Y	-5.07	6.94
9	M7	Y	-5.07	7.94
10	M8	Y	-5.07	.75
11	M8	Y	-2.54	1.75

Member Point Loads (BLC 20 : Type 3 + SU7 R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M5	Y	-37.57	.25
2	M5	Y	-37.57	6.25
3	M6	Y	-23.64	1.25
4	M7	Y	-23.64	3.12

Member Point Loads (BLC 21 : Type 3S2-40 + SU7 R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M5	Y	-37.57	.25
2	M5	Y	-37.57	6.25
3	M6	Y	-34.65	1.25
4	M7	Y	-34.65	3.12

Member Point Loads (BLC 22 : Type 3S3 + SU7 R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M5	Y	-37.57	.25
2	M5	Y	-37.57	6.25

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Member Point Loads (BLC 22 : Type 3S3 + SU7 R) (Continued)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
3	M6	Y	-35.42	1.25
4	M7	Y	-35.42	3.12

Member Point Loads (BLC 23 : Std A + SU7 R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M5	Y	-47.59	.25
2	M5	Y	-47.59	6.25
3	M6	Y	-37.57	1.25
4	M7	Y	-37.57	3.12

Member Point Loads (BLC 24 : Std B + SU7 R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M5	Y	-60	.25
2	M5	Y	-60	6.25
3	M6	Y	-37.57	1.25
4	M7	Y	-37.57	3.12

Member Point Loads (BLC 25 : Std C +SU7 R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M5	Y	-68.02	.25
2	M5	Y	-68.02	6.25
3	M6	Y	-37.57	1.25
4	M7	Y	-37.57	3.12

Member Point Loads (BLC 26 : P411 + SU7 R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M5	Y	-67.19	.25
2	M5	Y	-67.19	6.25
3	M6	Y	-37.57	1.25
4	M7	Y	-37.57	3.12

Member Point Loads (BLC 27 : P413 + SU7 R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M5	Y	-69.21	.25
2	M5	Y	-69.21	6.25
3	M6	Y	-37.57	1.25
4	M7	Y	-37.57	3.12

Member Point Loads (BLC 28 : Std C152b + SU7 R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M5	Y	-65.97	.25
2	M5	Y	-65.97	6.25
3	M6	Y	-37.57	1.25
4	M7	Y	-37.57	3.12

Member Point Loads (BLC 29 : Std C174b + SU7 R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M5	Y	-71.6	.25
2	M5	Y	-71.6	6.25
3	M6	Y	-37.57	1.25
4	M7	Y	-37.57	3.12

Member Point Loads (BLC 30 : Std C198 23 + SU7 R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
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Member Point Loads (BLC 30 : Std C198 23 + SU7 R) (Continued)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M5	Y	-73.61	.25
2	M5	Y	-73.61	6.25
3	M6	Y	-37.57	1.25
4	M7	Y	-37.57	3.12

Member Point Loads (BLC 31 : Std 214b + SU7 R)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M5	Y	-75.11	.25
2	M5	Y	-75.11	6.25
3	M6	Y	-37.57	1.25
4	M7	Y	-37.57	3.12

Member Point Loads (BLC 32 : Std C237b + SU7 R)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M5	Y	-71.12	.25
2	M5	Y	-71.12	6.25
3	M6	Y	-37.57	1.25
4	M7	Y	-37.57	3.12

Member Point Loads (BLC 33 : Std C256b + SU7 R)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M5	Y	-68.76	.25
2	M5	Y	-68.76	6.25
3	M6	Y	-37.57	1.25
4	M7	Y	-37.57	3.12

Member Point Loads (BLC 34 : Std C200j + SU7 R)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M5	Y	-78.57	.25
2	M5	Y	-78.57	6.25
3	M6	Y	-37.57	1.25
4	M7	Y	-37.57	3.12

Member Point Loads (BLC 35 : Type 3 + SU7 T)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M5	Y	-28.84	.25
2	M5	Y	-28.84	6.25
3	M6	Y	-18.3	1.25
4	M7	Y	-18.3	3.12

Member Point Loads (BLC 36 : Type 3S2-40 + SU7 T)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M5	Y	-28.84	.25
2	M5	Y	-28.84	6.25
3	M6	Y	-25.18	1.25
4	M7	Y	-25.18	3.12

Member Point Loads (BLC 37 : Type 3S3 + SU7 T)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M5	Y	-28.84	.25
2	M5	Y	-28.84	6.25
3	M6	Y	-26.24	1.25
4	M7	Y	-26.24	3.12

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Member Point Loads (BLC 38 : Std A + SU7 T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-35.85	.25
2	M5	Y	-35.85	6.25
3	M6	Y	-28.84	1.25
4	M7	Y	-28.84	3.12

Member Point Loads (BLC 39 : Std B + SU7 T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-43.96	.25
2	M5	Y	-43.96	6.25
3	M6	Y	-28.84	1.25
4	M7	Y	-28.84	3.12

Member Point Loads (BLC 40 : Std C +SU7 T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-48.21	.25
2	M5	Y	-48.21	6.25
3	M6	Y	-28.84	1.25
4	M7	Y	-28.84	3.12

Member Point Loads (BLC 41 : P411 + SU7 T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-40.07	.25
2	M5	Y	-40.07	6.25
3	M6	Y	-28.84	1.25
4	M7	Y	-28.84	3.12

Member Point Loads (BLC 42 : P413 + SU7 T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-44.17	.25
2	M5	Y	-44.17	6.25
3	M6	Y	-28.84	1.25
4	M7	Y	-28.84	3.12

Member Point Loads (BLC 43 : Std C152b + SU7 T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-47.78	.25
2	M5	Y	-47.78	6.25
3	M6	Y	-28.84	1.25
4	M7	Y	-28.84	3.12

Member Point Loads (BLC 44 : Std C174b + SU7 T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-48.14	.25
2	M5	Y	-48.14	6.25
3	M6	Y	-28.84	1.25
4	M7	Y	-28.84	3.12

Member Point Loads (BLC 45 : Std C198 23 + SU7 T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-42.29	.25
2	M5	Y	-42.29	6.25
3	M6	Y	-28.84	1.25
4	M7	Y	-28.84	3.12

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Member Point Loads (BLC 46 : Std 214b + SU7 T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-41.14	.25
2	M5	Y	-41.14	6.25
3	M6	Y	-28.84	1.25
4	M7	Y	-28.84	3.12

Member Point Loads (BLC 47 : Std C237b + SU7 T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-42.61	.25
2	M5	Y	-42.61	6.25
3	M6	Y	-28.84	1.25
4	M7	Y	-28.84	3.12

Member Point Loads (BLC 48 : Std C256b + SU7 T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-43.73	.25
2	M5	Y	-43.73	6.25
3	M6	Y	-28.84	1.25
4	M7	Y	-28.84	3.12

Member Point Loads (BLC 49 : Std C200j + SU7 T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-49.05	.25
2	M5	Y	-49.05	6.25
3	M6	Y	-28.84	1.25
4	M7	Y	-28.84	3.12

Member Point Loads (BLC 50 : Type 3 R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-23.64	.25
2	M5	Y	-23.64	6.25

Member Point Loads (BLC 51 : Type 3S2-40 R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-34.65	.25
2	M5	Y	-34.65	6.25

Member Point Loads (BLC 52 : Type 3S3 R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-35.42	.25
2	M5	Y	-35.42	6.25

Member Point Loads (BLC 53 : Std A R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-47.59	.25
2	M5	Y	-47.59	6.25

Member Point Loads (BLC 54 : Std B R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-60	.25
2	M5	Y	-60	6.25

Member Point Loads (BLC 55 : Std C R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
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Member Point Loads (BLC 55 : Std C R) (Continued)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-68.02	.25
2	M5	Y	-68.02	6.25

Member Point Loads (BLC 56 : P411 R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-67.19	.25
2	M5	Y	-67.19	6.25

Member Point Loads (BLC 57 : P413 R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-69.21	.25
2	M5	Y	-69.21	6.25

Member Point Loads (BLC 58 : Std C152b R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-65.97	.25
2	M5	Y	-65.97	6.25

Member Point Loads (BLC 59 : Std C174b R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-71.6	.25
2	M5	Y	-71.6	6.25

Member Point Loads (BLC 60 : Std C198 23 R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-73.61	.25
2	M5	Y	-73.61	6.25

Member Point Loads (BLC 61 : Std 214b R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-75.11	.25
2	M5	Y	-75.11	6.25

Member Point Loads (BLC 62 : Std C237b R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-71.12	.25
2	M5	Y	-71.12	6.25

Member Point Loads (BLC 63 : Std C256b R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-68.76	.25
2	M5	Y	-68.76	6.25

Member Point Loads (BLC 64 : Std C200j R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-78.57	.25
2	M5	Y	-78.57	6.25

Member Point Loads (BLC 65 : Type 3 T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-18.3	.25
2	M5	Y	-18.3	6.25

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Member Point Loads (BLC 66 : Type 3S2-40 T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-25.18	.25
2	M5	Y	-25.18	6.25

Member Point Loads (BLC 67 : Type 3S3 T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-26.24	.25
2	M5	Y	-26.24	6.25

Member Point Loads (BLC 68 : Std A T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-35.85	.25
2	M5	Y	-35.85	6.25

Member Point Loads (BLC 69 : Std B T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-43.96	.25
2	M5	Y	-43.96	6.25

Member Point Loads (BLC 70 : Std C T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-48.21	.25
2	M5	Y	-48.21	6.25

Member Point Loads (BLC 71 : P411 T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-40.07	.25
2	M5	Y	-40.07	6.25

Member Point Loads (BLC 72 : P413 T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-44.17	.25
2	M5	Y	-44.17	6.25

Member Point Loads (BLC 73 : Std C152b T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-47.78	.25
2	M5	Y	-47.78	6.25

Member Point Loads (BLC 74 : Std C174b T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-48.14	.25
2	M5	Y	-48.14	6.25

Member Point Loads (BLC 75 : Std C198 23 T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-42.29	.25
2	M5	Y	-42.29	6.25

Member Point Loads (BLC 76 : Std 214b T)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M5	Y	-41.14	.25
2	M5	Y	-41.14	6.25

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Member Point Loads (BLC 77 : Std C237b T)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M5	Y	-42.61	.25
2	M5	Y	-42.61	6.25

Member Point Loads (BLC 78 : Std C256b T)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M5	Y	-43.73	.25
2	M5	Y	-43.73	6.25

Member Point Loads (BLC 79 : Std C200j T)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M5	Y	-49.05	.25
2	M5	Y	-49.05	6.25

Member Distributed Loads (BLC 1 : Pier Cap Weight)

	Member Label	Direction	Start Magnitude[k/ft.d...]	End Magnitude[k/ft.d...]	Start Location[ft.%]	End Location[ft.%]
1	M1	Y	-3	-358	0	7.16
2	M1	Y	-595	-921	7.16	8.16
3	M1	Y	-921	-99	8.16	9
4	M1	Y	-99	-968	9	13.16
5	M1	Y	-968	-557	13.16	15
6	M1	Y	-343	-3	15	100

Member Distributed Loads (BLC 14 : Braking Force)

	Member Label	Direction	Start Magnitude[k/ft.d...]	End Magnitude[k/ft.d...]	Start Location[ft.%]	End Location[ft.%]
1	M4	Z	.907	.907	0	0
2	M5	Z	.907	.907	0	0
3	M6	Z	.907	.907	0	0
4	M7	Z	.907	.907	0	0
5	M8	Z	.907	.907	0	0

Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distributed Area (Me... Surface (...)
1	Pier Cap Weight	DL						6
2	Lanes Seperate	LL				2	22	
3	Lanes Together R	LL				2	22	
4	Trucks Seperate	LL				2	4	
5	Trucks Together R	LL				2	4	
6	Trucks Together L	LL				2	4	
7	Centrifugal Force	LL				6		
8	Noncomp Dead	DL				6		
9	Superimposed Dead	DL				5		
10	Lanes Together L	LL				2	22	
11	1 Truck Left	LL				1	2	
12	MDX Bracing Load	DL				4		
13	1 Lane Left	LL				1	11	
14	Braking Force	LL				2		5
15	Max Lane Torque	LL				2	22	
16	Max Truck Torque	LL				2	4	
17	Unit Torque at F	LL				1		
18	1 Truck Right	LL				1	2	
19	1 Lane Right	LL				1	11	
20	Type 3 + SU7 R	LL				2	4	
21	Type 3S2-40 + SU7 R	LL				2	4	

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 Designer : jdf
 Job Number : 090147

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Apr 26, 2010
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Basic Load Cases (Continued)

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distributed Area (Me...	Surface (...)
22	Type 3S3 + SU7 R	LL				2	4		
23	Std A + SU7 R	LL				2	4		
24	Std B + SU7 R	LL				2	4		
25	Std C +SU7 R	LL				2	4		
26	P411 + SU7 R	LL				2	4		
27	P413 + SU7 R	LL				2	4		
28	Std C152b + SU7 R	LL				2	4		
29	Std C174b + SU7 R	LL				2	4		
30	Std C198_23 + SU7 R	LL				2	4		
31	Std 214b + SU7 R	LL				2	4		
32	Std C237b + SU7 R	LL				2	4		
33	Std C256b + SU7 R	LL				2	4		
34	Std C200j + SU7 R	LL				2	4		
35	Type 3 + SU7 T	LL				2	4		
36	Type 3S2-40 + SU7 T	LL				2	4		
37	Type 3S3 + SU7 T	LL				2	4		
38	Std A + SU7 T	LL				2	4		
39	Std B + SU7 T	LL				2	4		
40	Std C +SU7 T	LL				2	4		
41	P411 + SU7 T	LL				2	4		
42	P413 + SU7 T	LL				2	4		
43	Std C152b + SU7 T	LL				2	4		
44	Std C174b + SU7 T	LL				2	4		
45	Std C198_23 + SU7 T	LL				2	4		
46	Std 214b + SU7 T	LL				2	4		
47	Std C237b + SU7 T	LL				2	4		
48	Std C256b + SU7 T	LL				2	4		
49	Std C200j + SU7 T	LL				2	4		
50	Type 3 R	LL				1	2		
51	Type 3S2-40 R	LL				1	2		
52	Type 3S3 R	LL				1	2		
53	Std A R	LL				1	2		
54	Std B R	LL				1	2		
55	Std C R	LL				1	2		
56	P411 R	LL				1	2		
57	P413 R	LL				1	2		
58	Std C152b R	LL				1	2		
59	Std C174b R	LL				1	2		
60	Std C198_23 R	LL				1	2		
61	Std 214b R	LL				1	2		
62	Std C237b R	LL				1	2		
63	Std C256b R	LL				1	2		
64	Std C200j R	LL				1	2		
65	Type 3 T	LL				1	2		
66	Type 3S2-40 T	LL				1	2		
67	Type 3S3 T	LL				1	2		
68	Std A T	LL				1	2		
69	Std B T	LL				1	2		
70	Std C T	LL				1	2		
71	P411 T	LL				1	2		
72	P413 T	LL				1	2		
73	Std C152b T	LL				1	2		
74	Std C174b T	LL				1	2		
75	Std C198_23 T	LL				1	2		
76	Std 214b T	LL				1	2		
77	Std C237b T	LL				1	2		
78	Std C256b T	LL				1	2		

Company : LHB
Designer : jdf
Job Number : 090147

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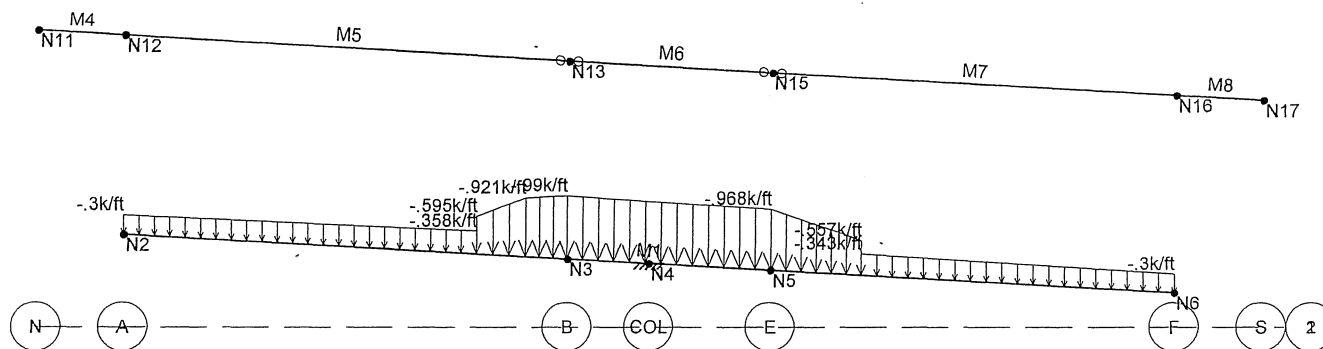
Apr 26, 2010
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Checked By: CJM

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Load Combinations (Continued)

	Description	Sol...	PD...	SR...	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor
53	Std C256b R	Yes			63	1.596	7	1.18	14	2.13								
54	Std C200j R	Yes			64	1.596	7	1.35	14	1.67								
55	Type 3 T	Yes			65	1.596	7	.31	14	.4								
56	Type 3S2-40 T	Yes			66	1.596	7	.43	14	.67								
57	Type 3S3 T	Yes			67	1.596	7	.45	14	.67								
58	Std A T	Yes			68	1.596	7	.62	14	.87								
59	Std B T	Yes			69	1.596	7	.76	14	1.13								
60	Std C T	Yes			70	1.596	7	.83	14	1.33								
61	P411 T	Yes			71	1.596	7	.69	14	1.73								
62	P413 T	Yes			72	1.596	7	.76	14	2.13								
63	Std C152b T	Yes			73	1.596	7	.82	14	1.27								
64	Std C174b T	Yes			74	1.596	7	.83	14	1.45								
65	Std C198 23 T	Yes			75	1.596	7	.73	14	1.65								
66	Std 214b T	Yes			76	1.596	7	.71	14	1.78								
67	Std C237b T	Yes			77	1.596	7	.73	14	1.98								
68	Std C256b T	Yes			78	1.596	7	.76	14	2.13								
69	Std C200j T	Yes			79	1.596	7	.84	14	1.67								

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Loads: BLC 1, Pier Cap Weight

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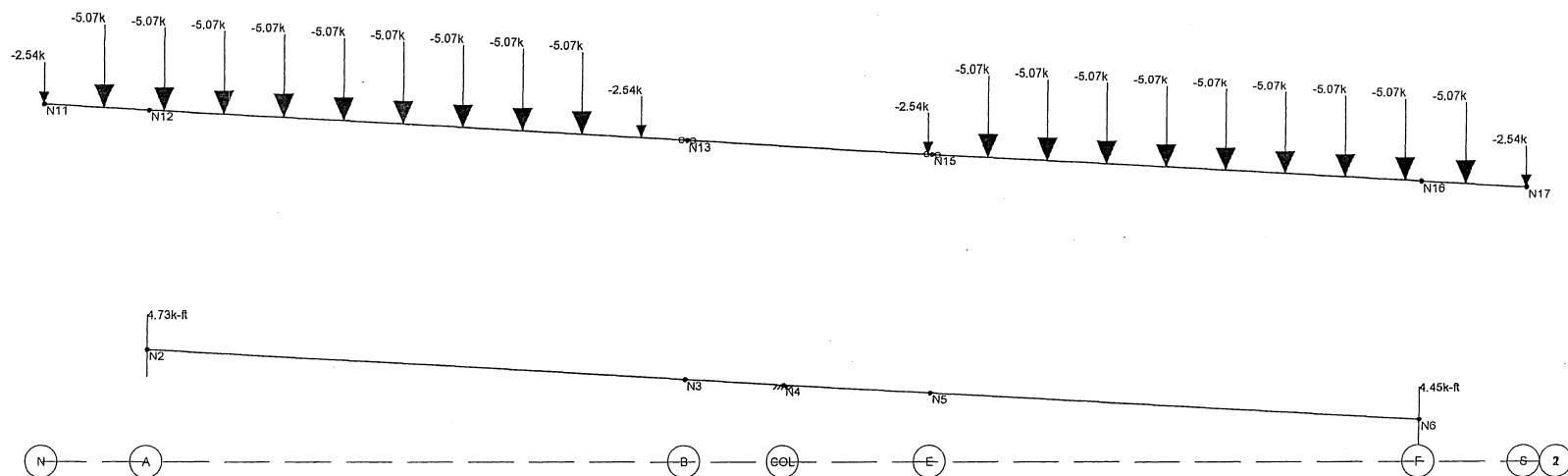
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Jan 19, 2010 at 3:56 PM

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42-24



Loads: BLC 2, Lanes Separate

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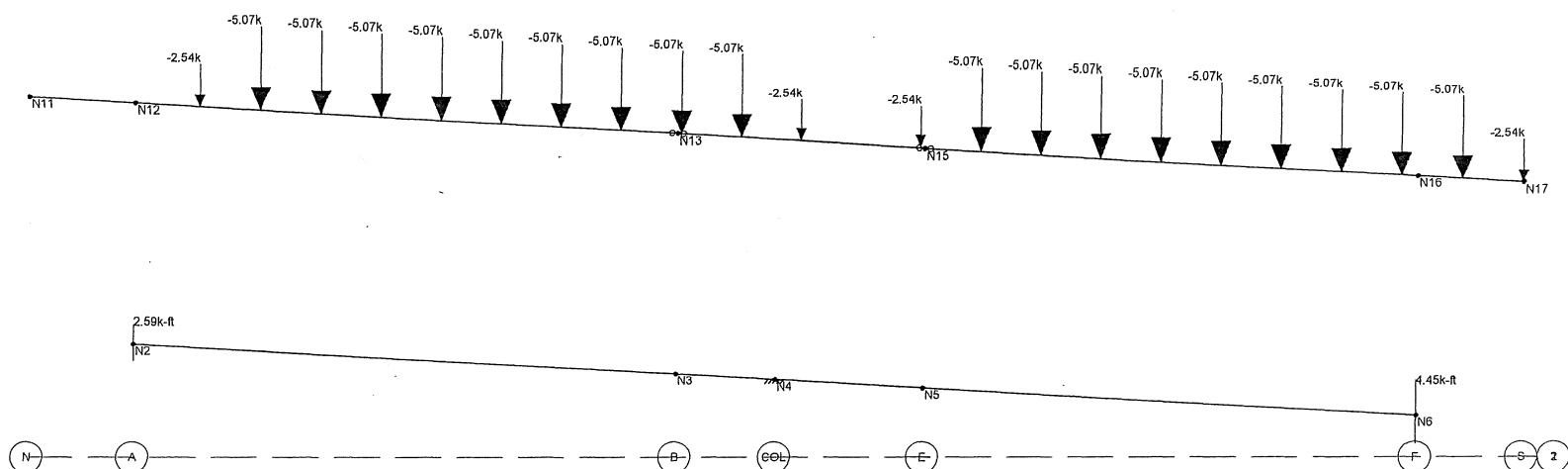
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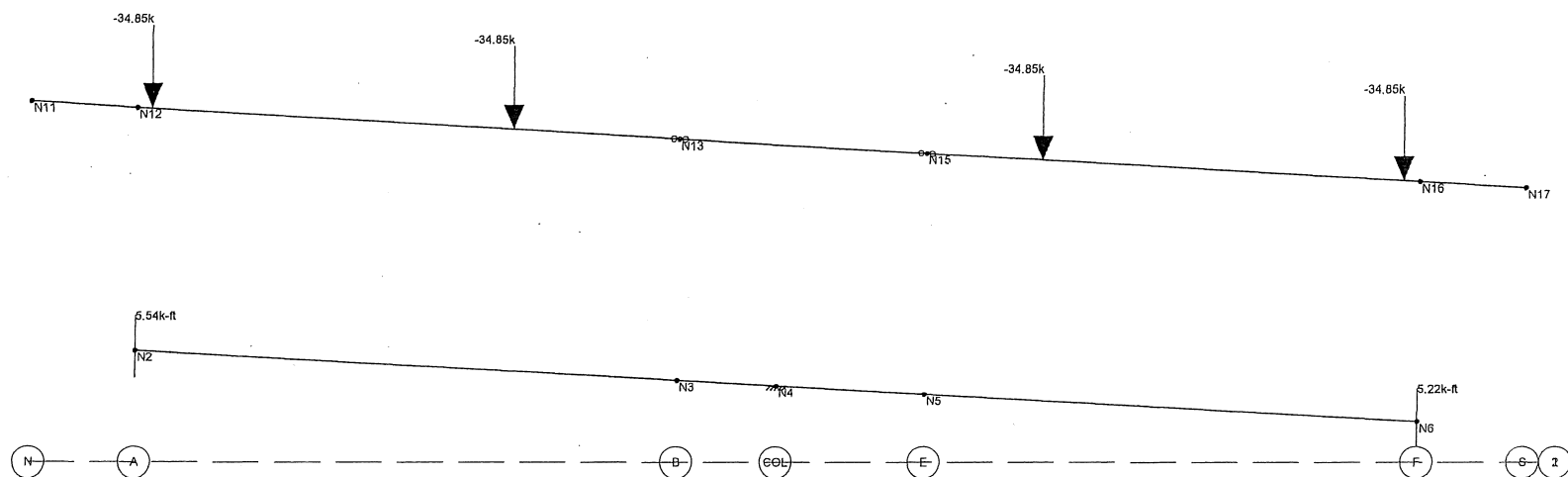
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Mar 9, 2010 at 3:49 PM

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K-25





Loads: BLC 4, Trucks Seperate

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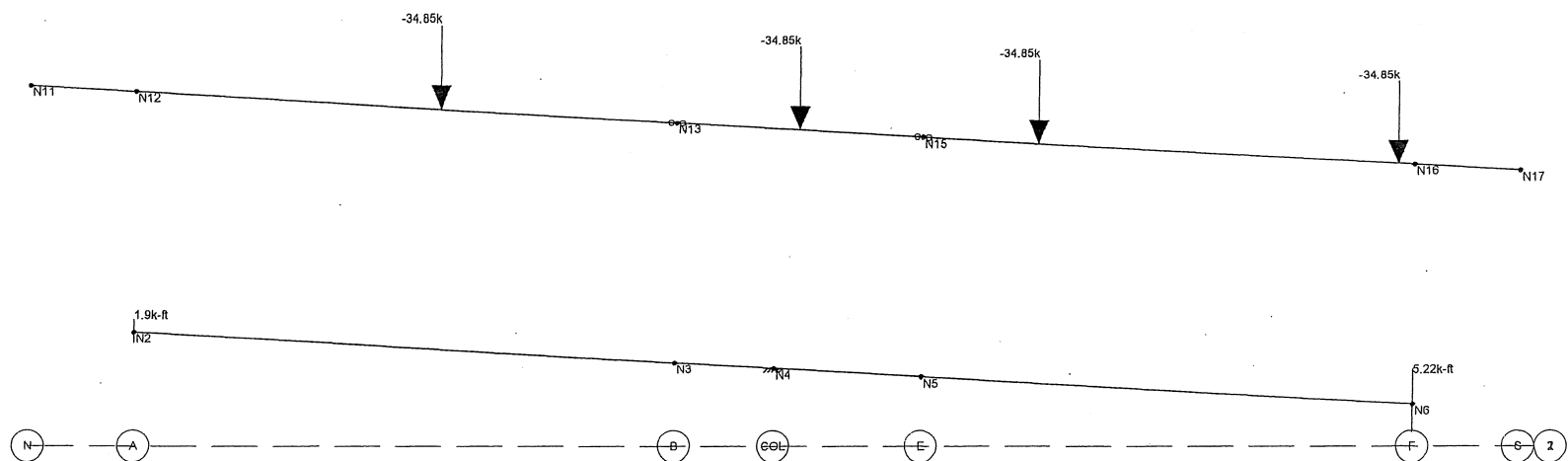
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Bridge 69801, 3A Pier 4

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K-27



Loads: BLC 5, Trucks Together R

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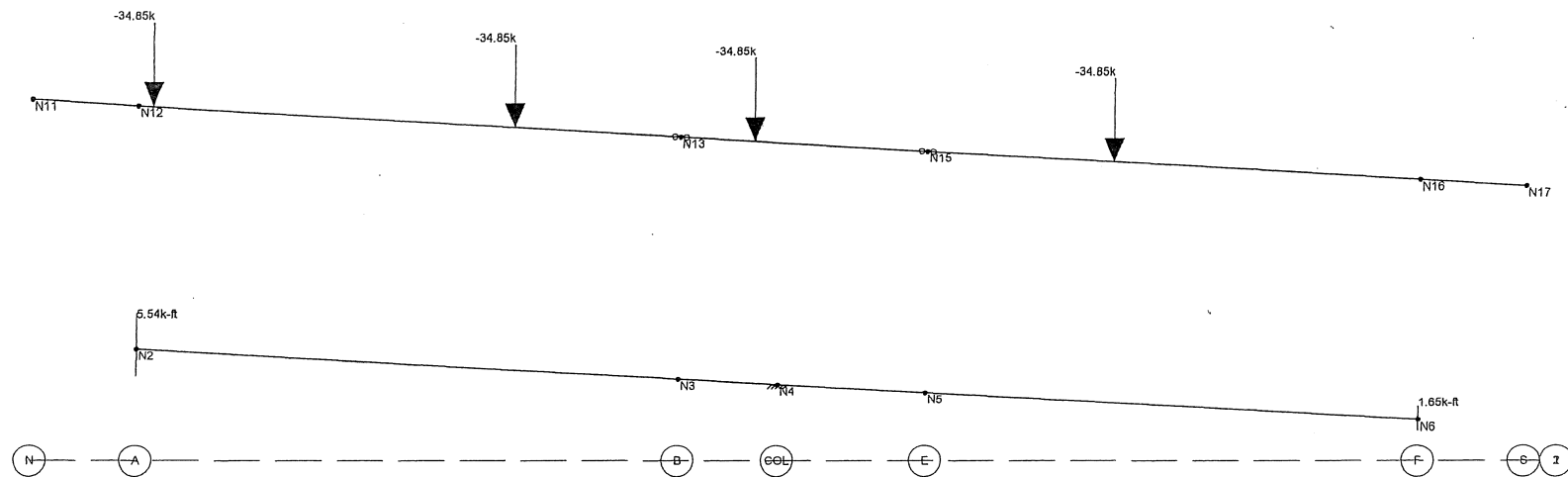
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K-28



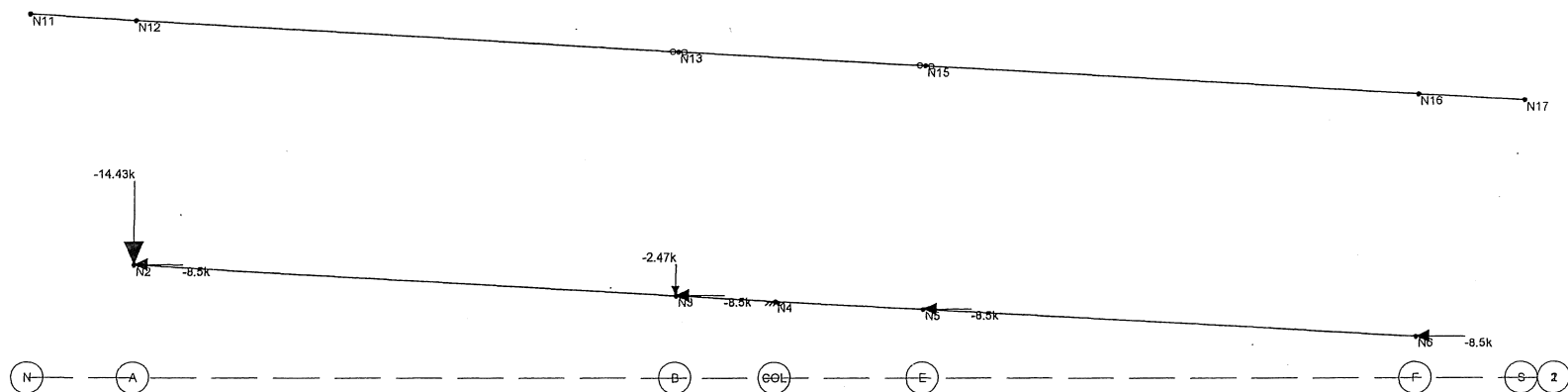
Loads: BLC 6, Trucks Together L

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090147

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16-29



Loads: BLC 7, Centrifugal Force

LHB

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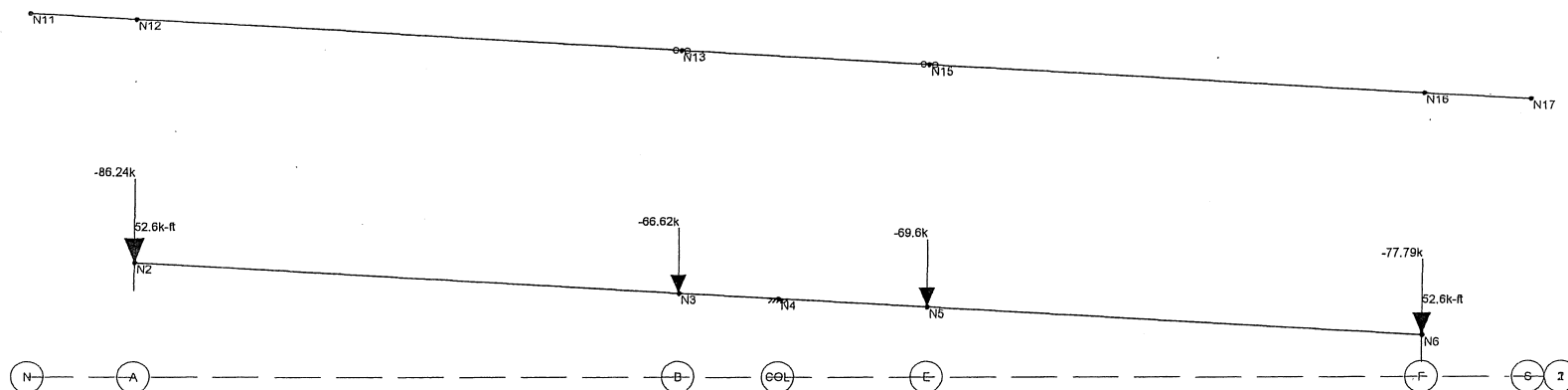
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09-7



Loads: BLC 8, Noncomp Dead

LHB

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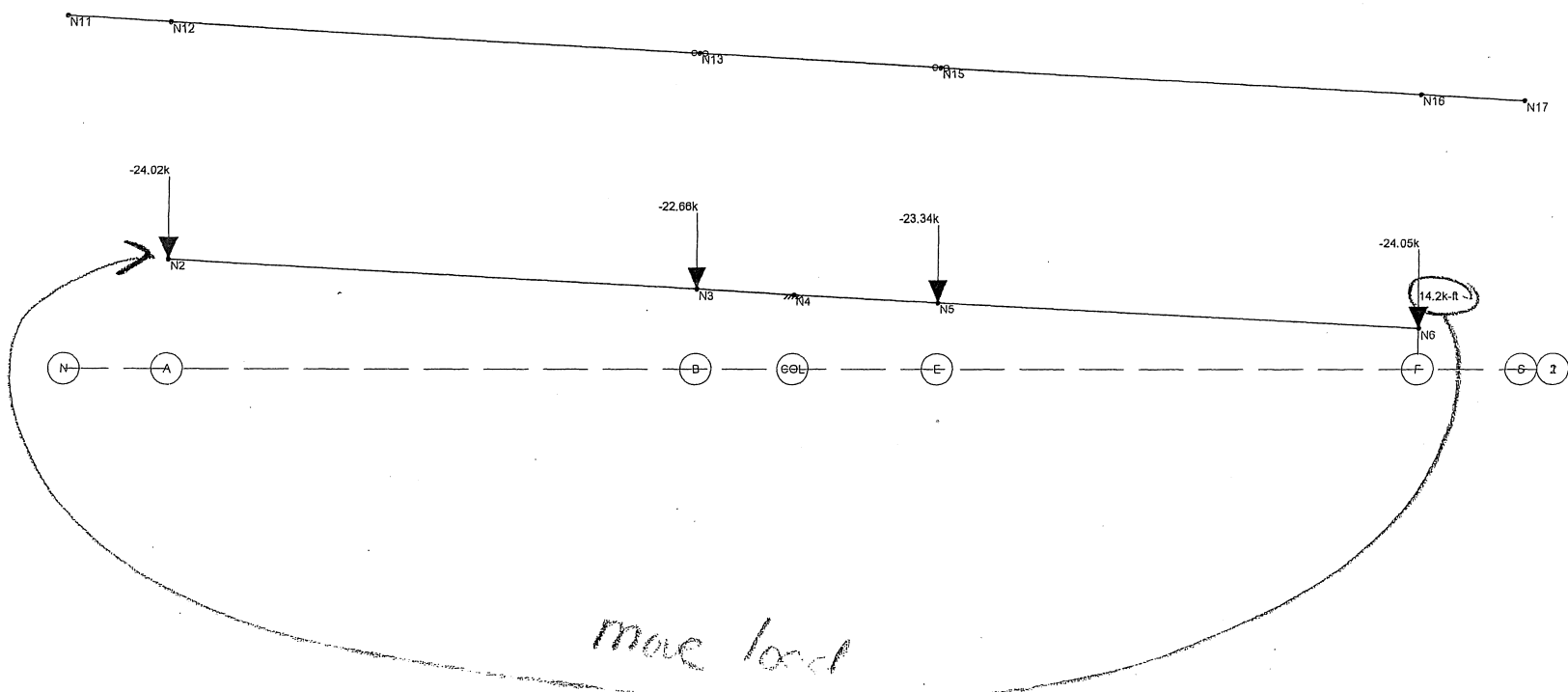
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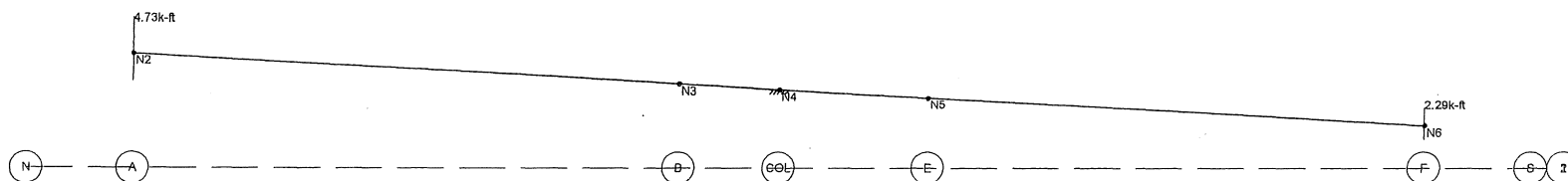
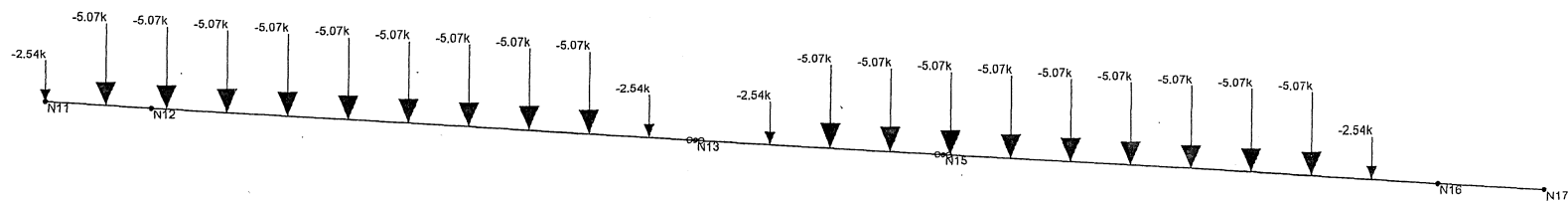
13-31



Loads: BLC 9, Superimposed Dead

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jdf		Mar 9, 2010 at 3:50 PM
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11-29



Loads: BLC 10, Lanes Together L

LHB

jdf

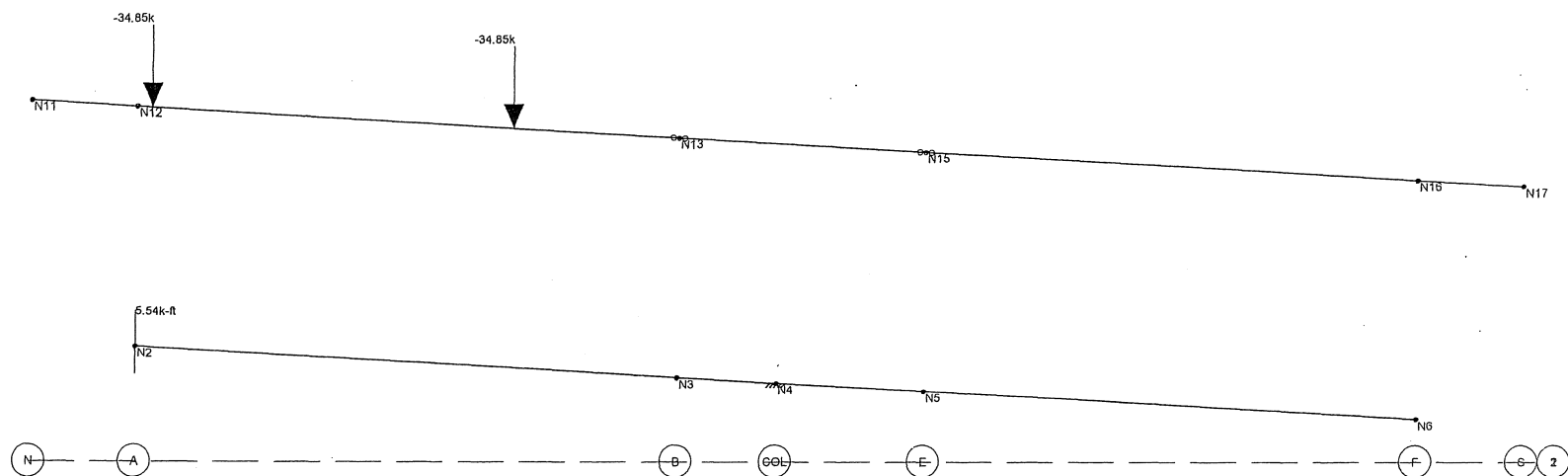
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Bridge 69801 3A Pier 4

Mar 9, 2010 at 3:50 PM

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12-33



Loads: BLC 11, 1 Truck Left

LHB

jdf

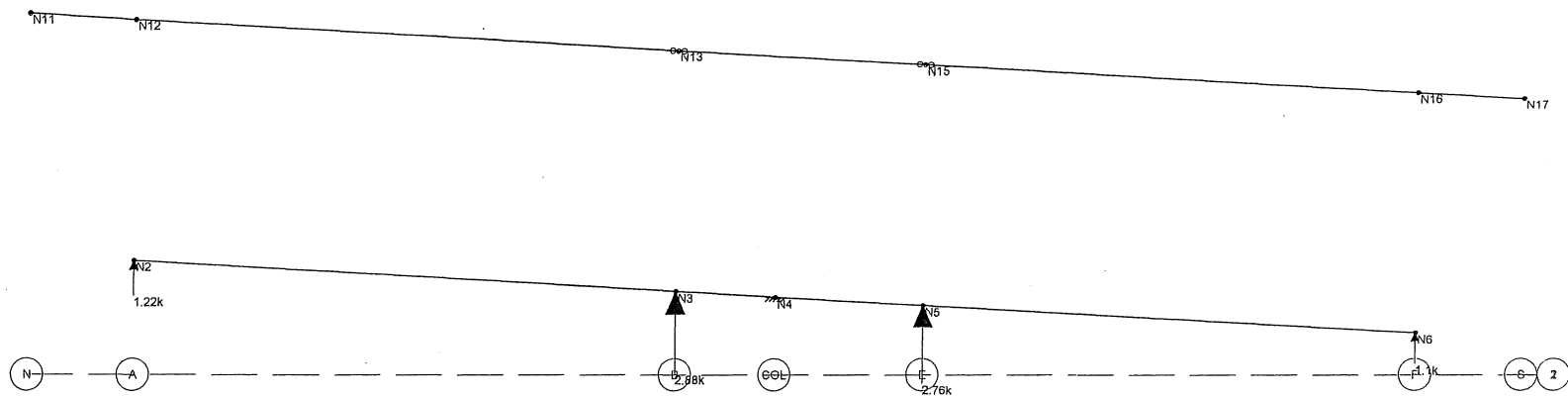
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Bridge 69801 3A Pier 4

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1K-34



Loads: BLC 12, MDX Bracing Load

LHB

jdf

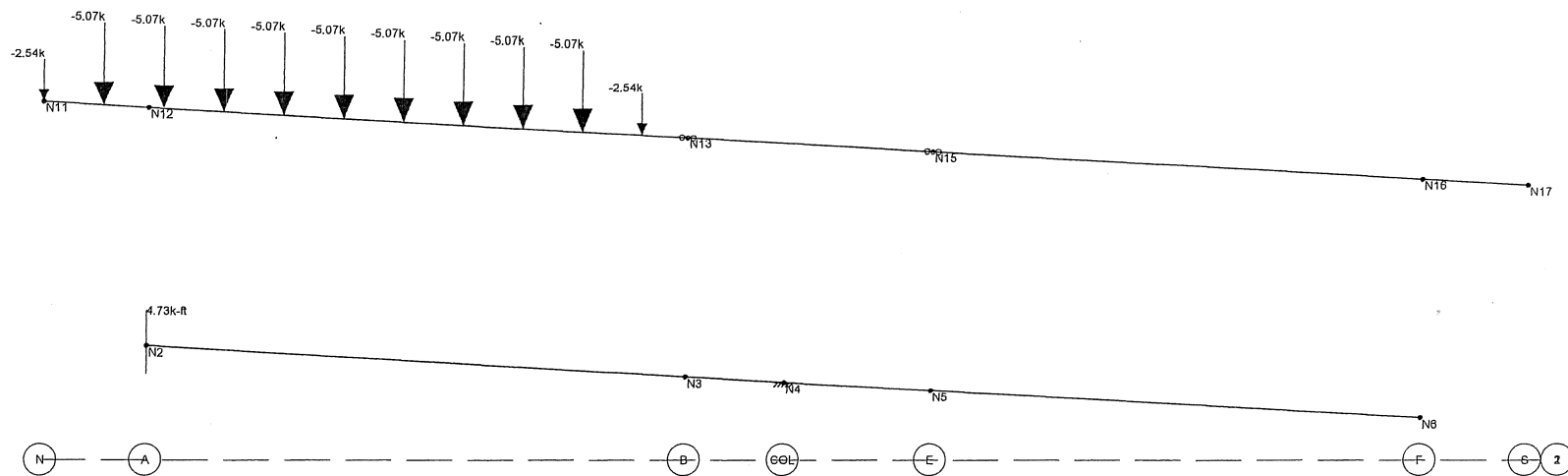
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Bridge 69801 3A Pier 4

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K-35



Loads: BLC 13, Lane Left Only

LHB

jdf

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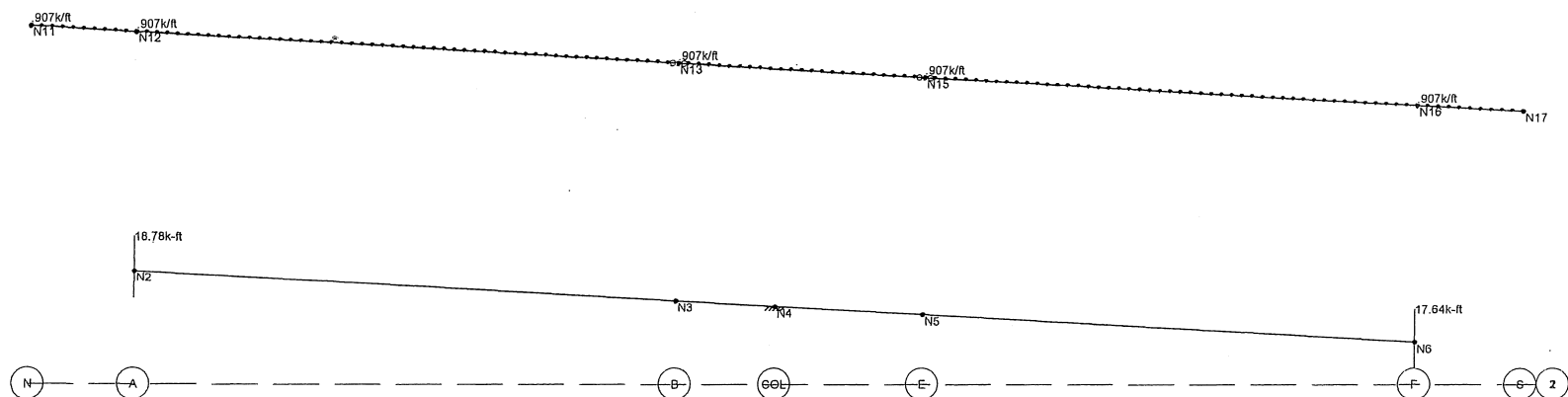
Bridge 69801 3A Pier 4

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1K-26

Y
Z
L_x



Loads: BLC 14, Braking Force

LHB

jdf

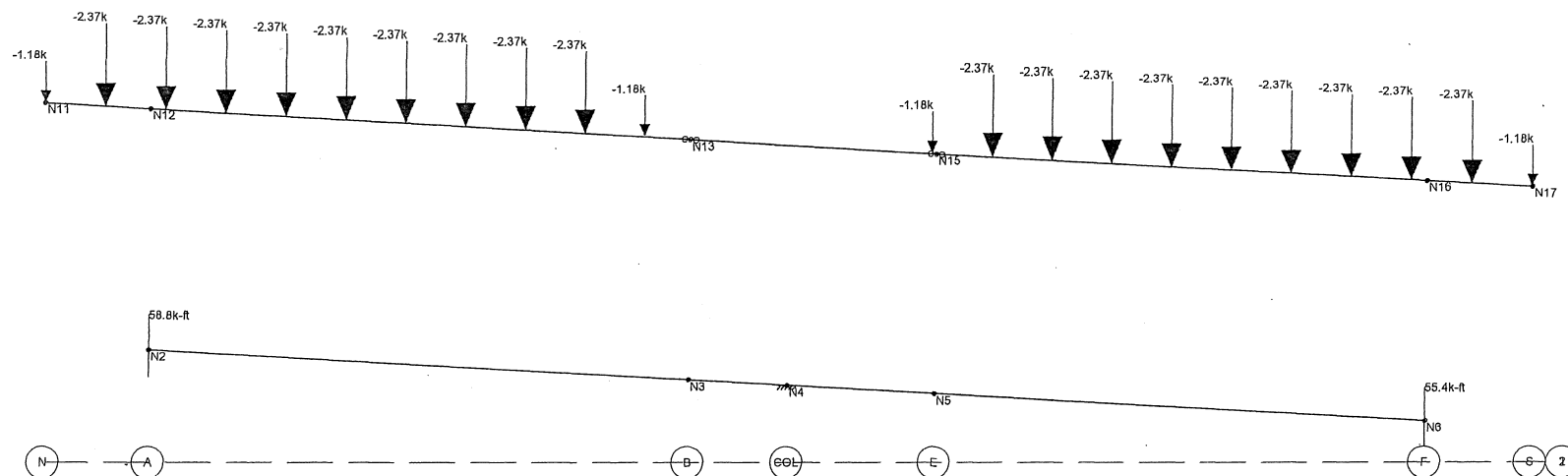
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Bridge 69801 3A Pier 4

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Loads: BLC 15, Max Lane Torque

LHB

jdf

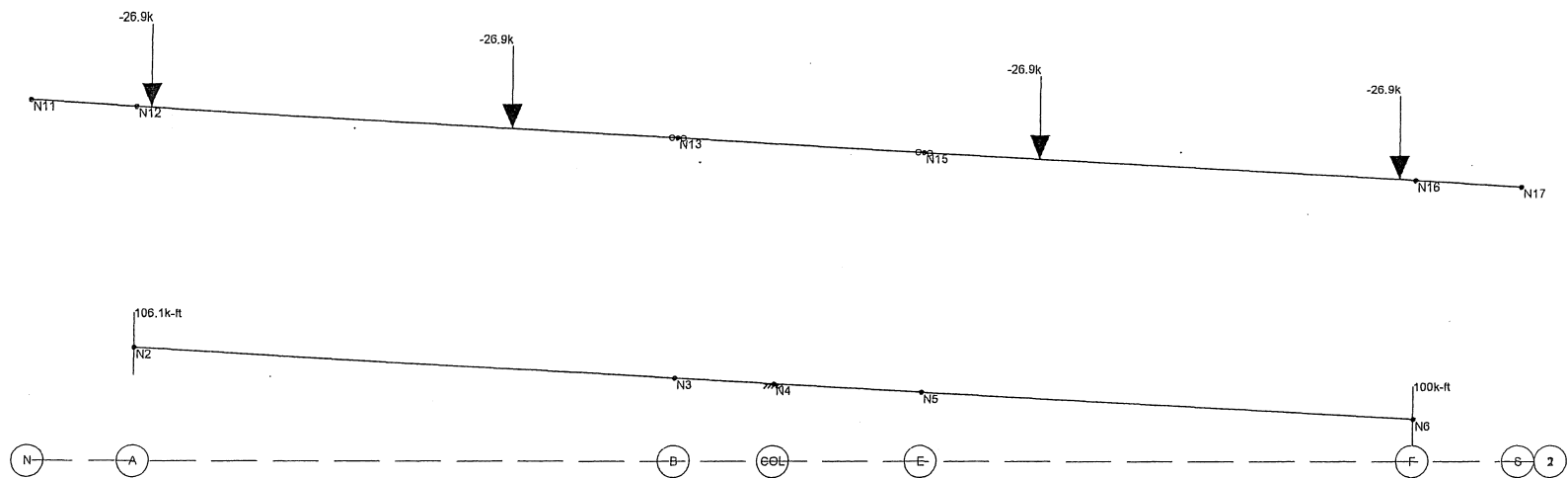
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Bridge 69801 3A Pier 4

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88-7



Loads: BLC 16, Max Truck Torque

LHB

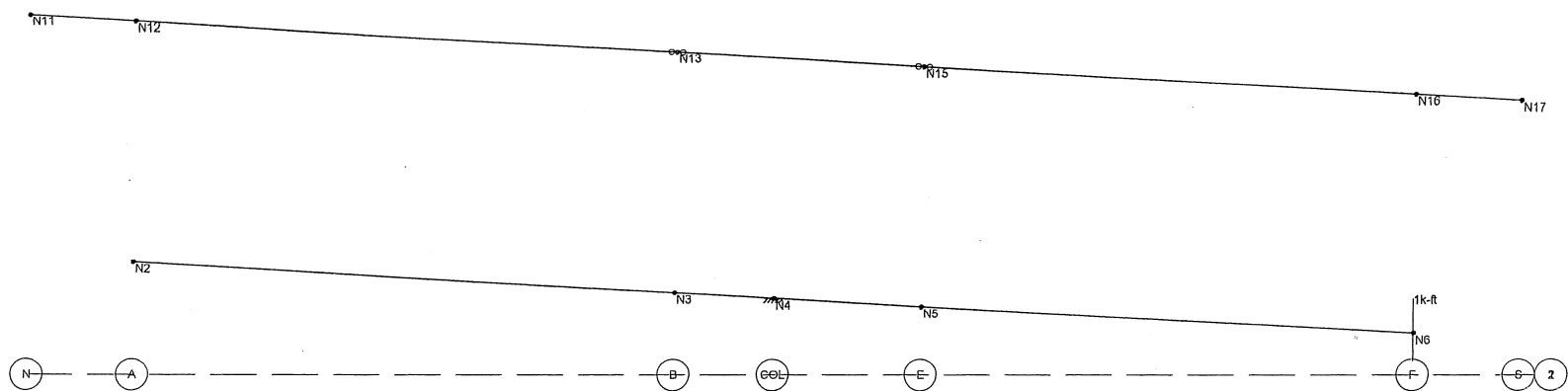
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090147

Bridge 69801 3A Pier 4

Mar 9, 2010 at 3:51 PM

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Loads: BLC 17, Unit Torque at F

LHB

jdf

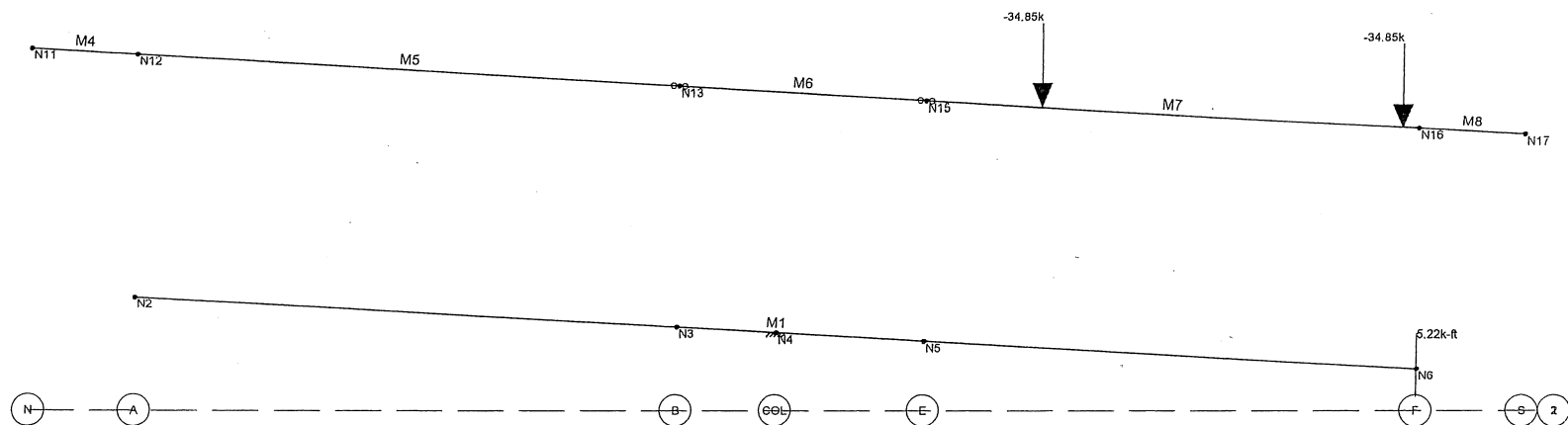
090147

Bridge 69801 3A Pier 4

Mar 9, 2010 at 3:51 PM

090147_3A_P4_Pier.r3d

1C-40



Loads: BLC 18, 1 Truck Right

LHB

jdf

090147

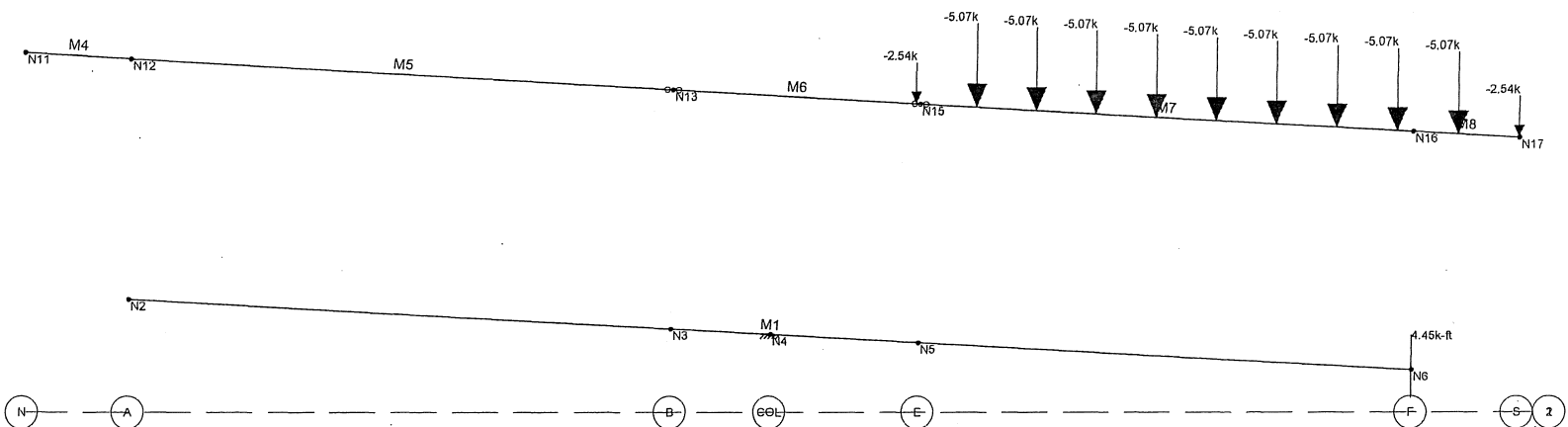
Bridge 69801 3A Pier 4

1

Apr 15, 2010 at 3:21 PM

090147_3A_P4_Pier.r3d

16-41



Loads: BLC 19, 1 Lane Right

LHB

jdf

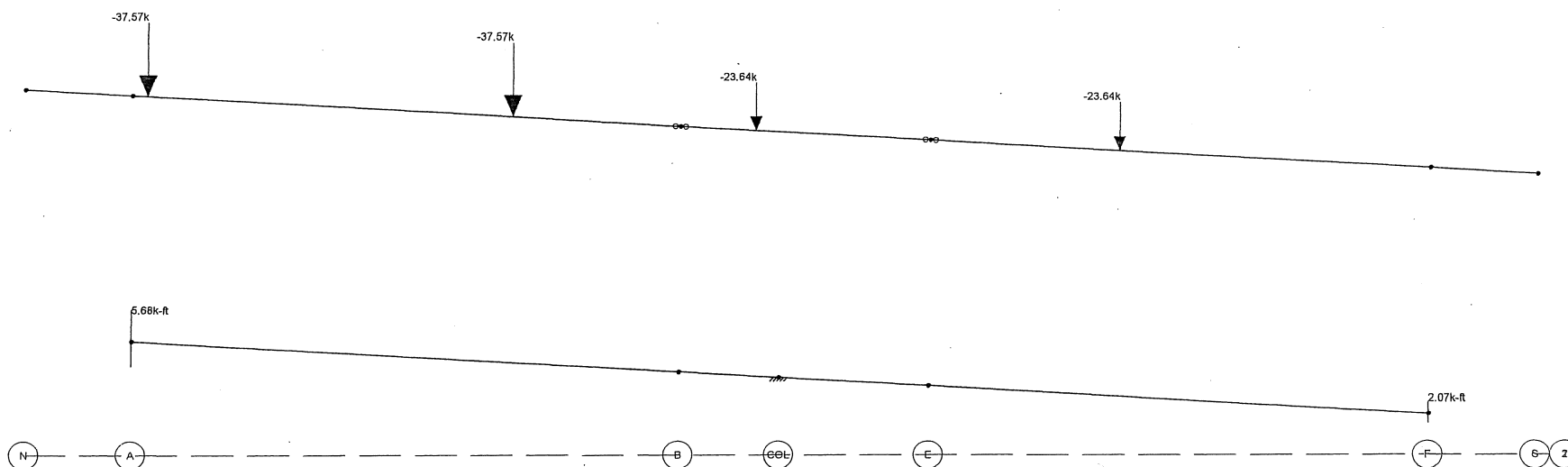
090147

Bridge 69801 3A Pier 4

1

Apr 15, 2010 at 3:21 PM

090147_3A_P4_Pier.r3d



Loads: BLC 20, Type 3 + SU7 R

LHB

jdf

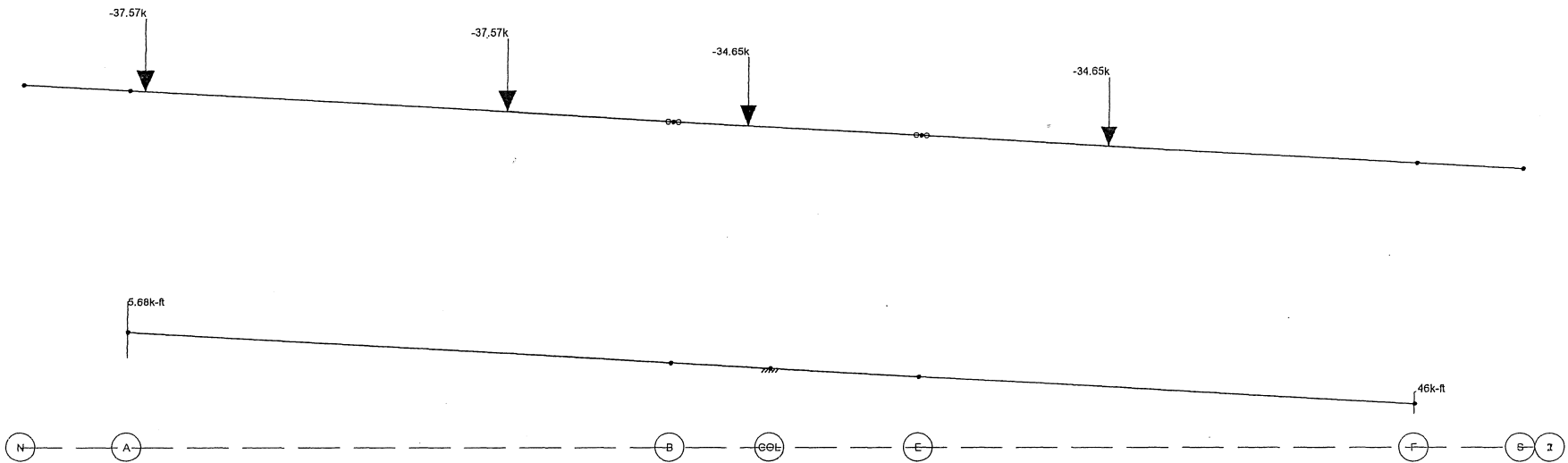
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:34 PM

090147_3A_P4_Pier.r3d

K-47



Loads: BLC 21, Type 3S2-40 + SU7 R

LHB

jdf

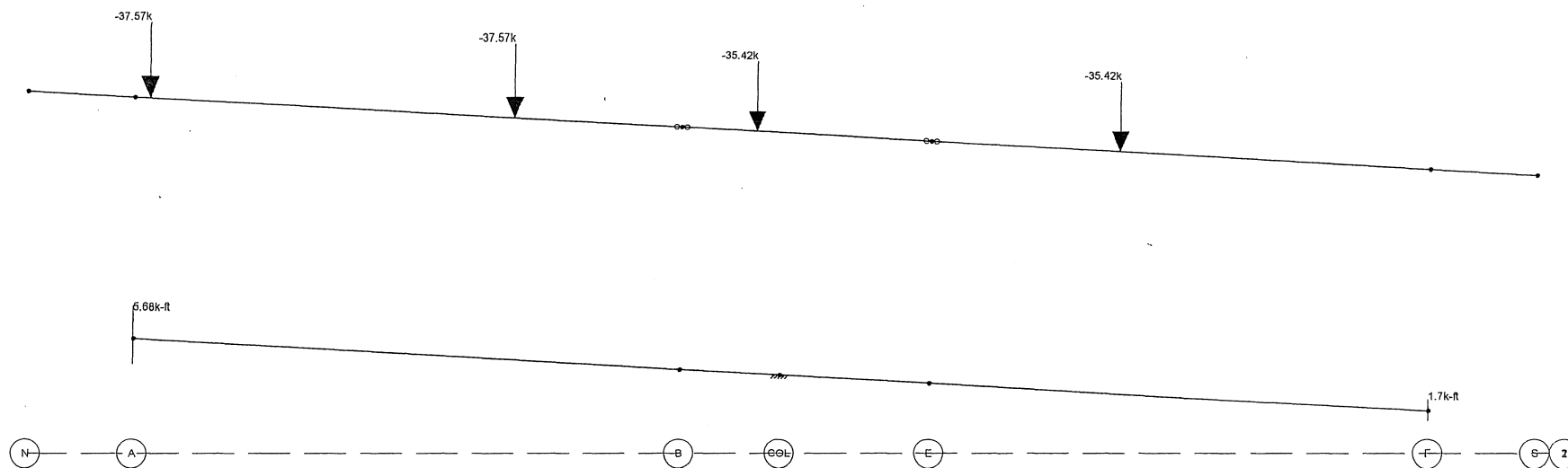
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:34 PM

090147_3A_P4_Pier.r3d

K-44



Loads: BLC 22, Type 3S3 + SU7 R

LHB

jdf

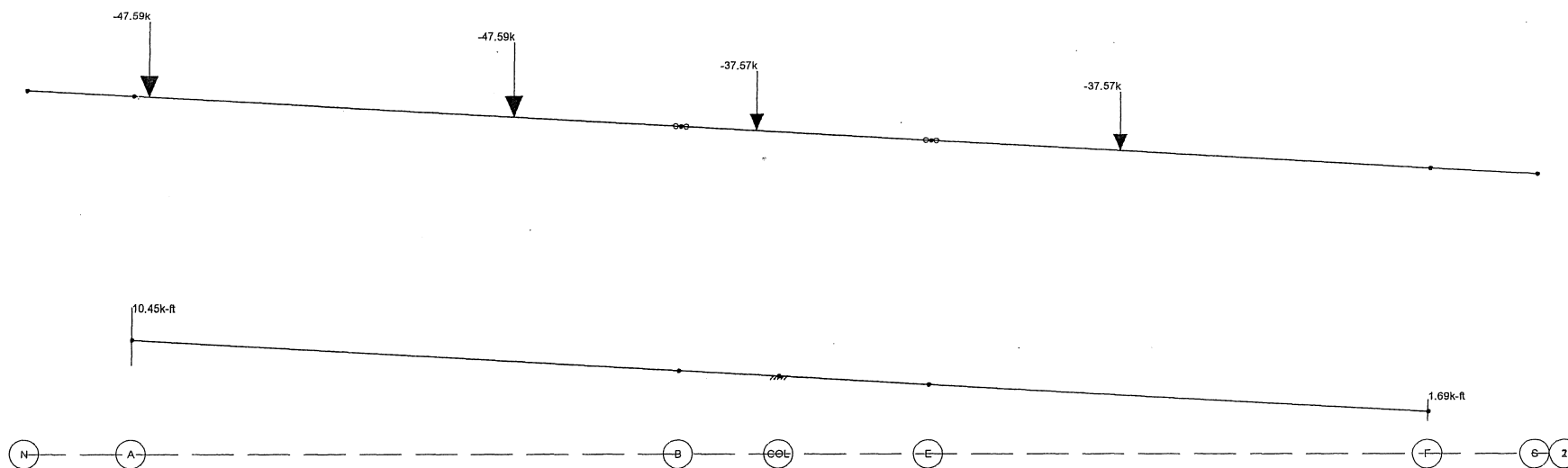
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:34 PM

090147_3A_P4_Pier.r3d

16-415



Loads: BLC 23, Std A + SU7 R

LHB

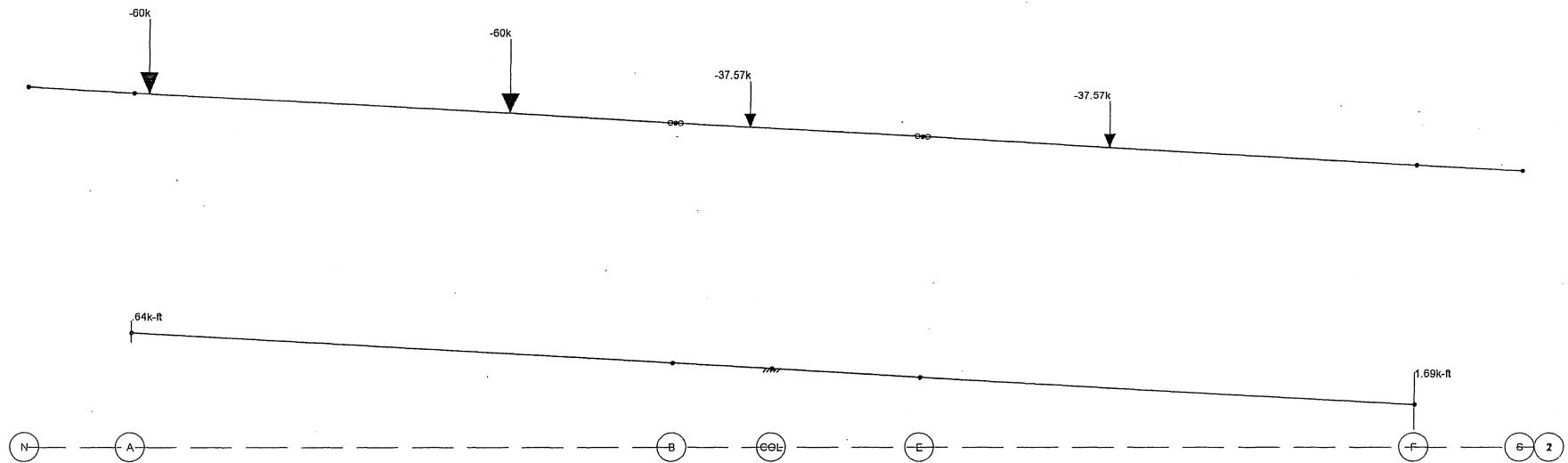
jdf

090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:34 PM

090147_3A_P4_Pier.r3d



Loads: BLC 24, Std B + SU7 R

LHB

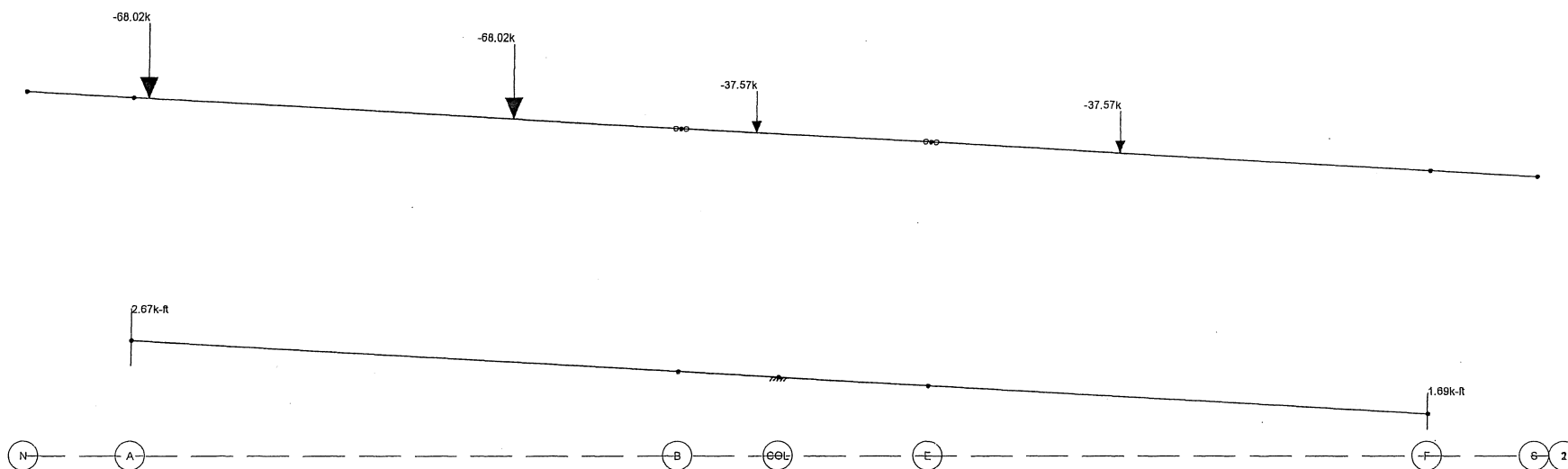
jdf

090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:34 PM

090147_3A_P4_Pier.r3d



Loads: BLC 25, Std C +SU7 R

LHB

jdf

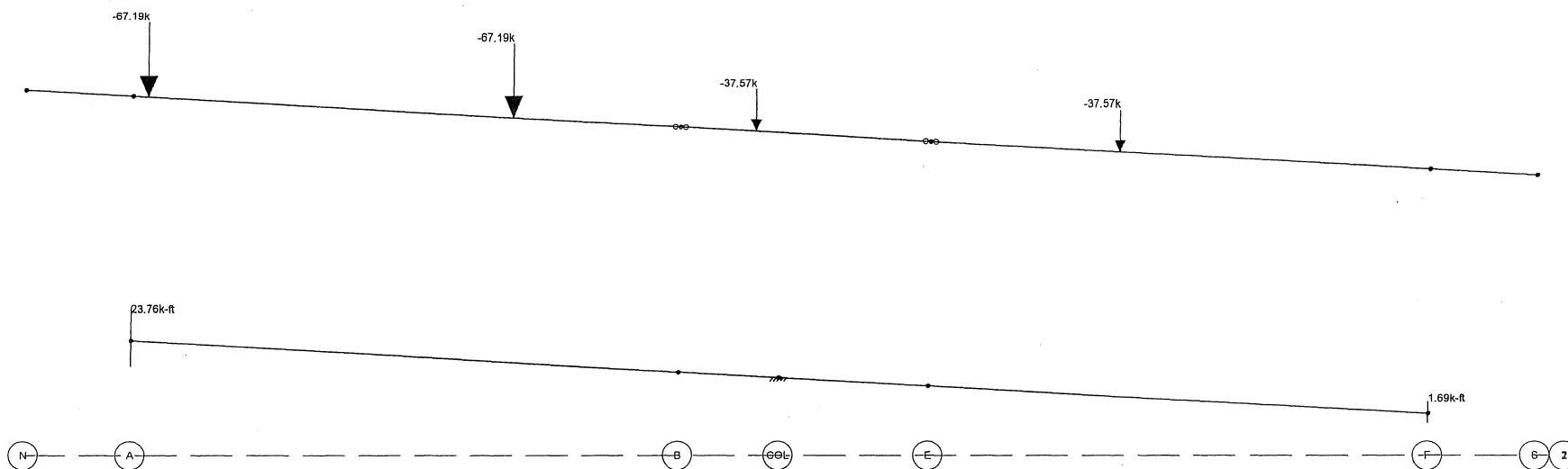
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:35 PM

090147_3A_P4_Pier.r3d

87-11



Loads: BLC 26, P411 + SU7 R

LHB

jdf

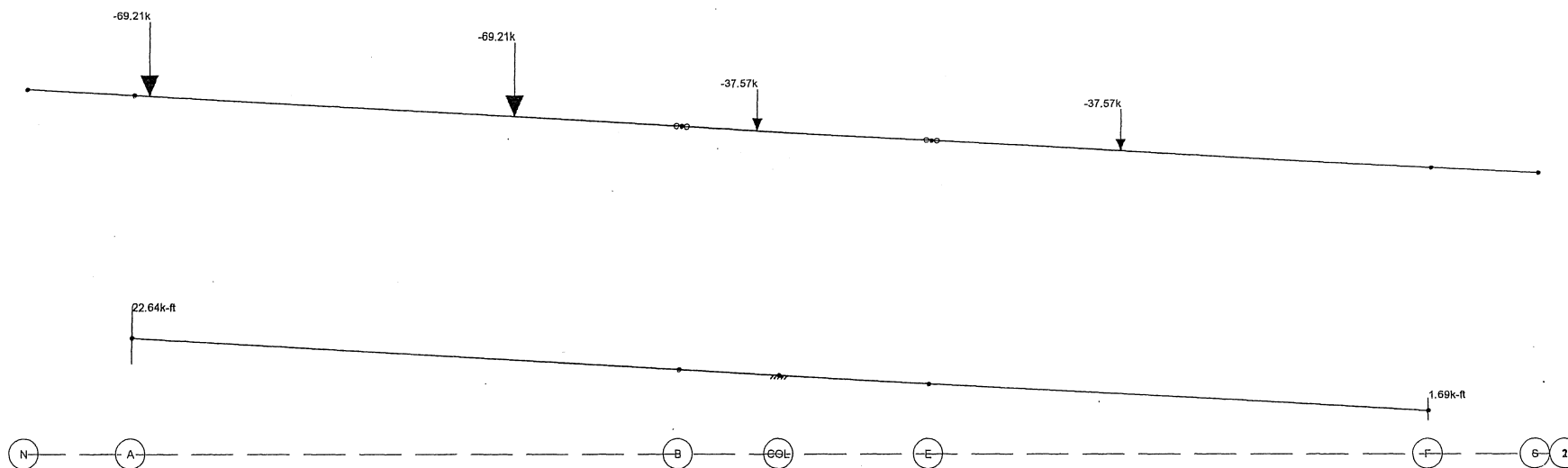
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:35 PM

090147_3A_P4_Pier.r3d

67-7



Loads: BLC 27, P413 + SU7 R

LHB

jdf

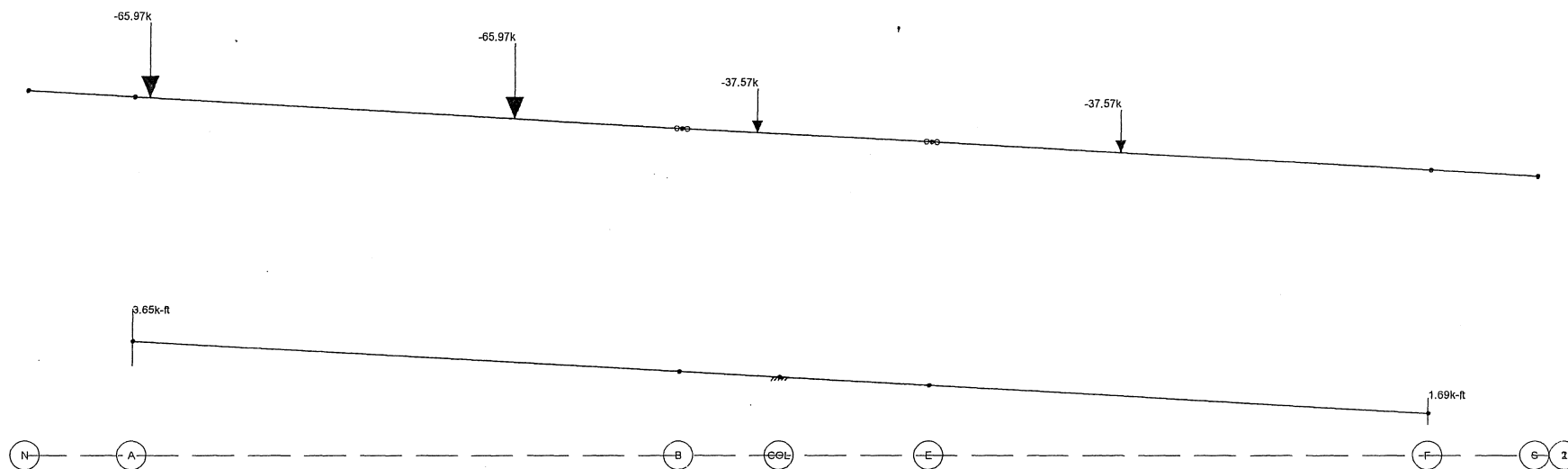
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:35 PM

090147_3A_P4_Pier.r3d

K-50



Loads: BLC 28, Sid C152b + SU7 R

LHB

jdf

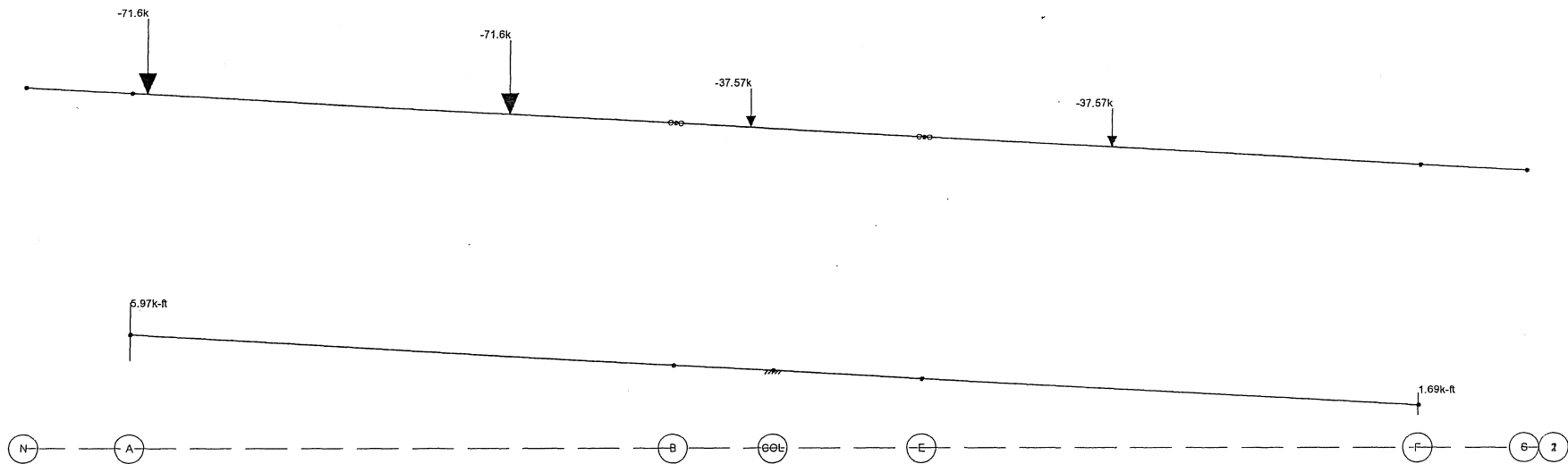
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:35 PM

090147_3A_P4_Pier.r3d

K-51



Loads: BLC 29, Std C174b + SU7 R

LHB

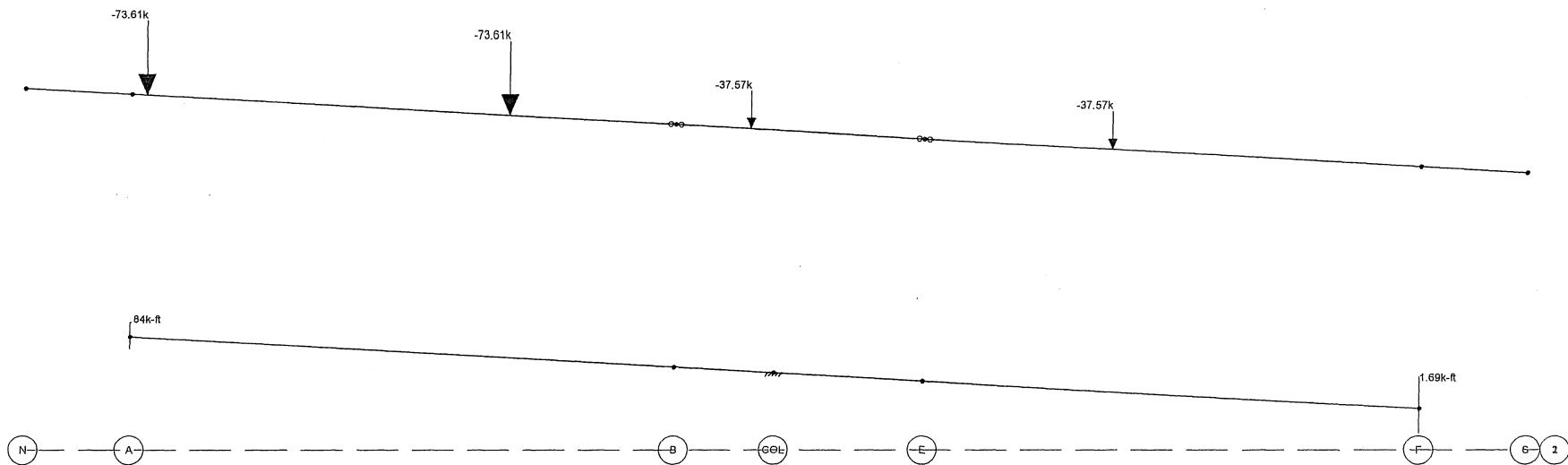
jdf

090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:35 PM

090147_3A_P4_Pier.r3d



Loads: BLC 30, Std C198_23 + SU7 R

LHB

jdf

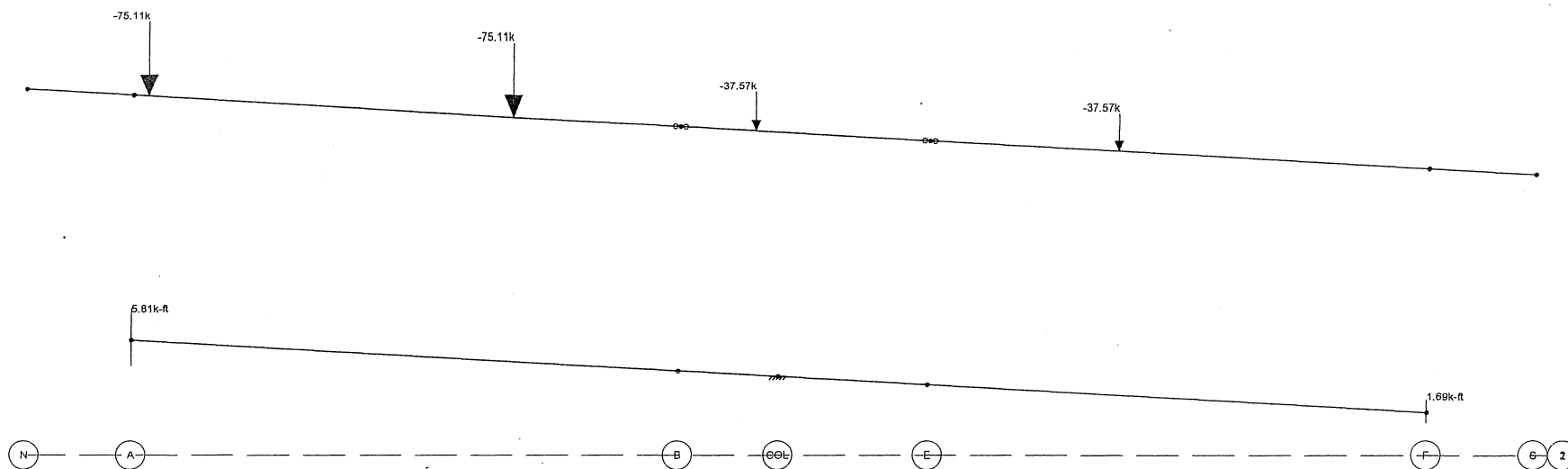
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:35 PM

090147_3A_P4_Pier.r3d

K-53



Loads: BLC 31, Std 214b + SU7 R

LHB

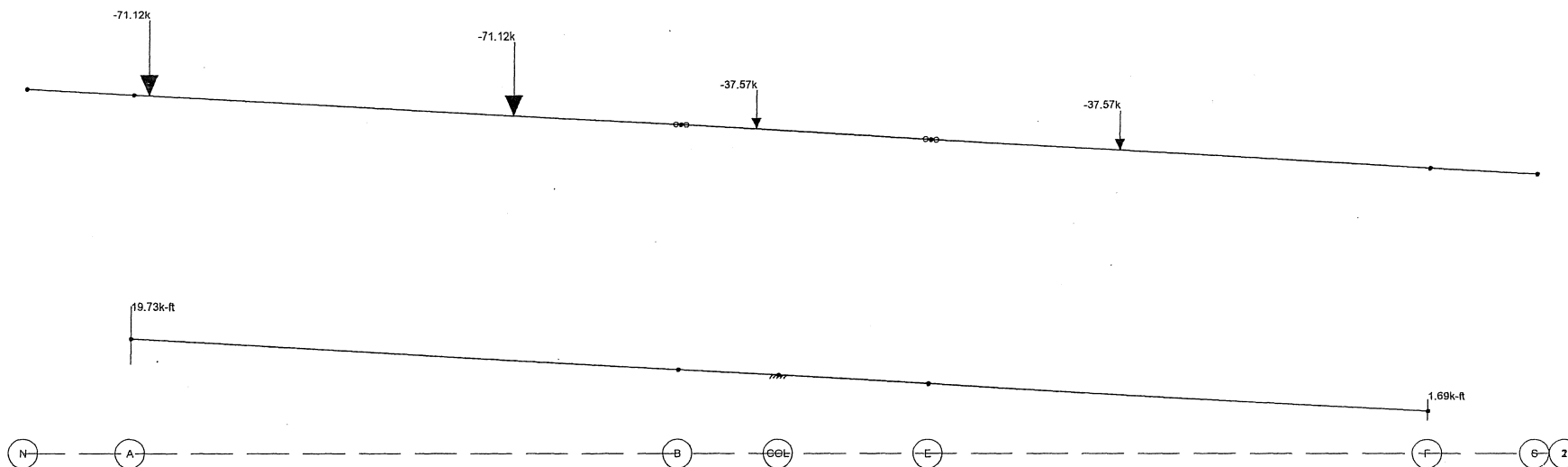
jdf

090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:35 PM

090147_3A_P4_Pier.r3d



Loads: BLC 32, Sid C237b + SU7 R

LHB

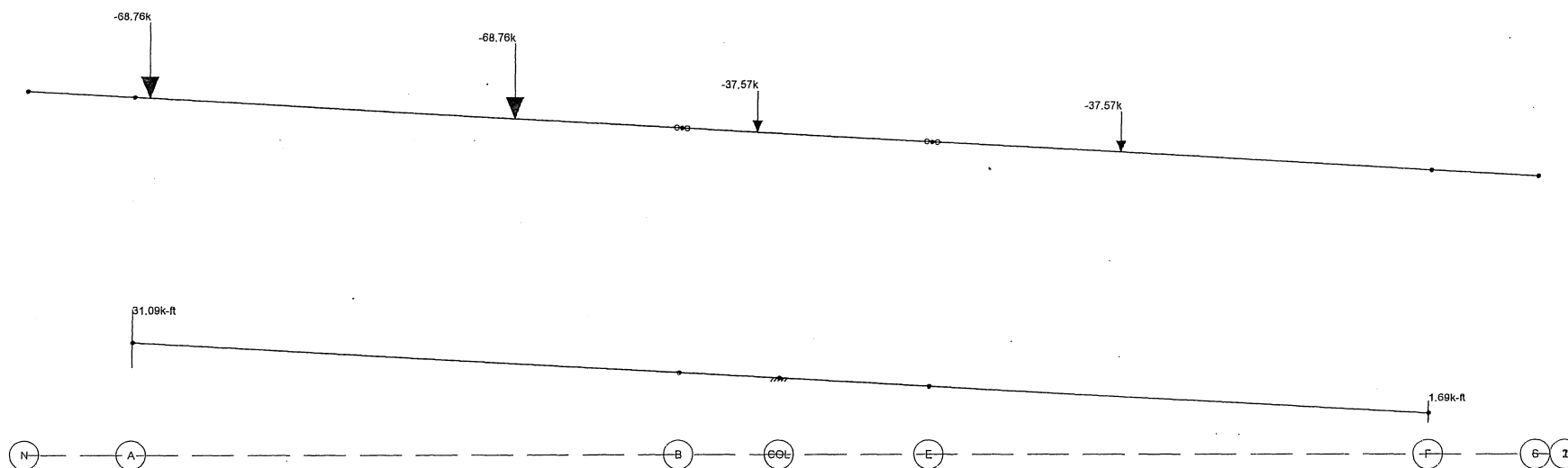
jdf

090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:35 PM

090147_3A_P4_Pier.r3d



Loads: BLC 33, Std C256b + SU7 R

LHB

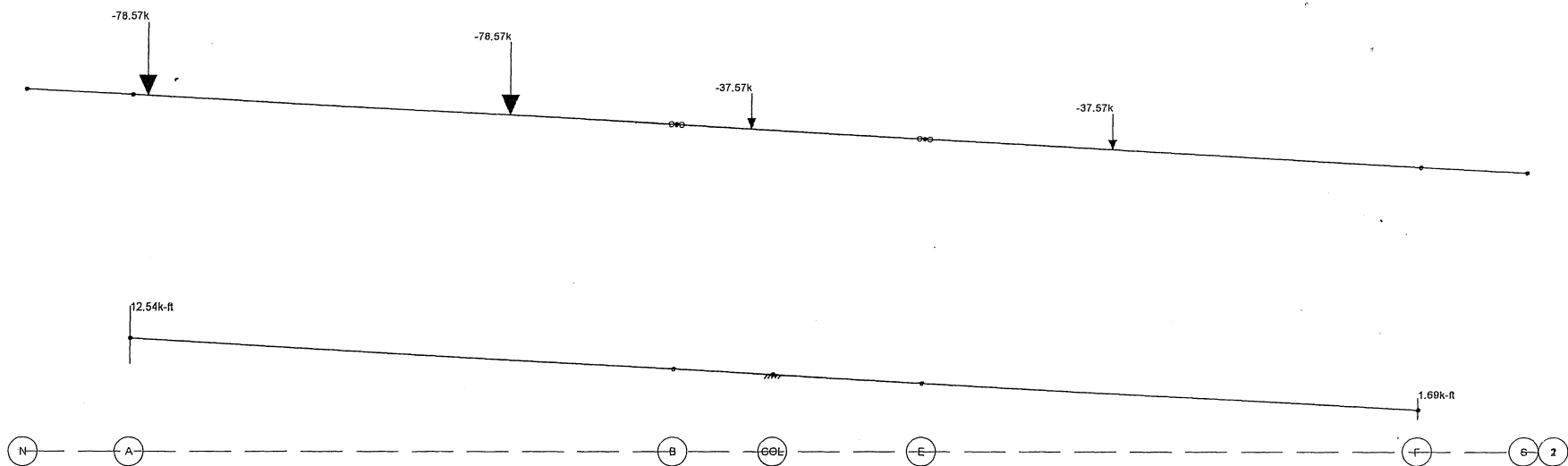
jdf

090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:35 PM

090147_3A_P4_Pier.r3d



Loads: BLC 34, Std C200j + SU7 R

LHB

jdf

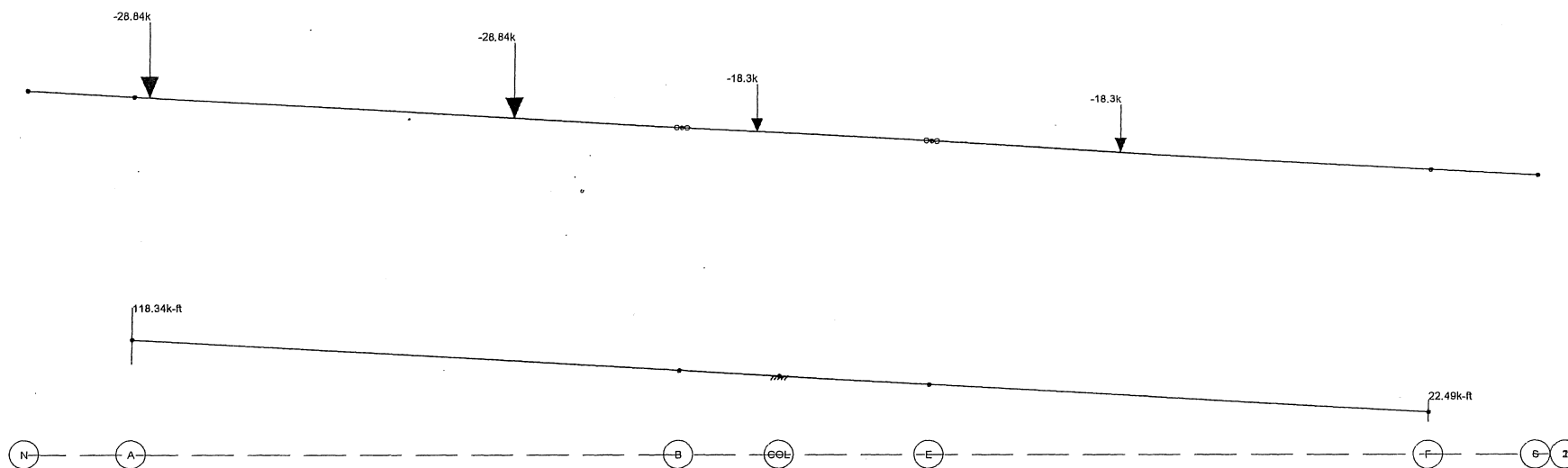
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:35 PM

090147_3A_P4_Pier.r3d

K-57



Loads: BLC 35, Type 3 + SU7 T

LHB

jdf

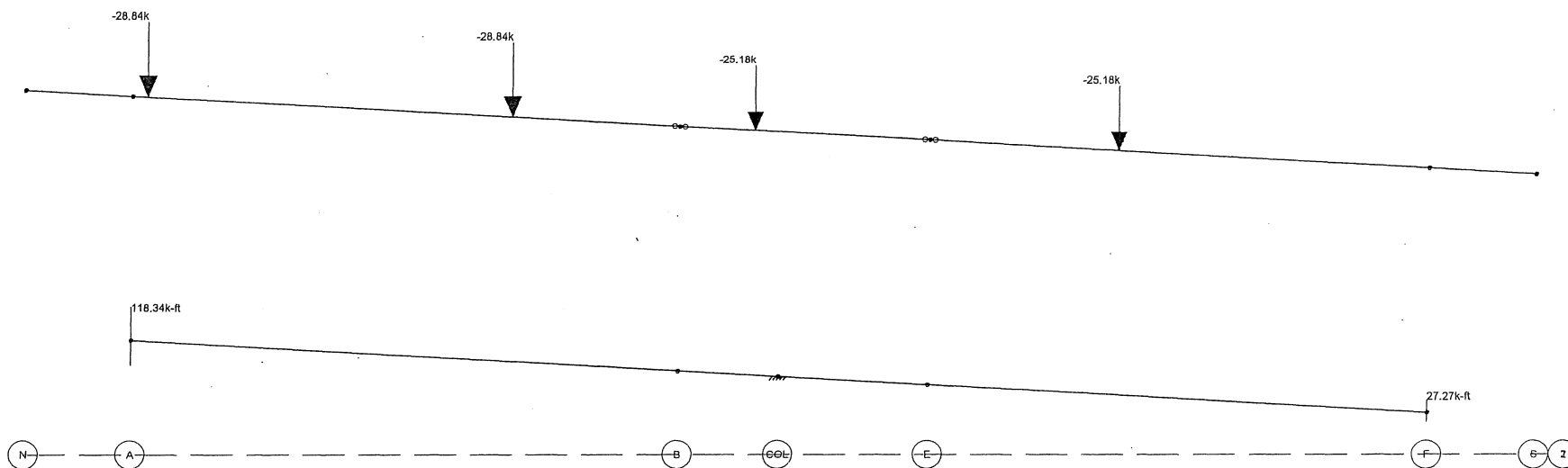
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:36 PM

090147_3A_P4_Pier.r3d

K-58



Loads: BLC 36, Type 3S2-40 + SU7 T

LHB

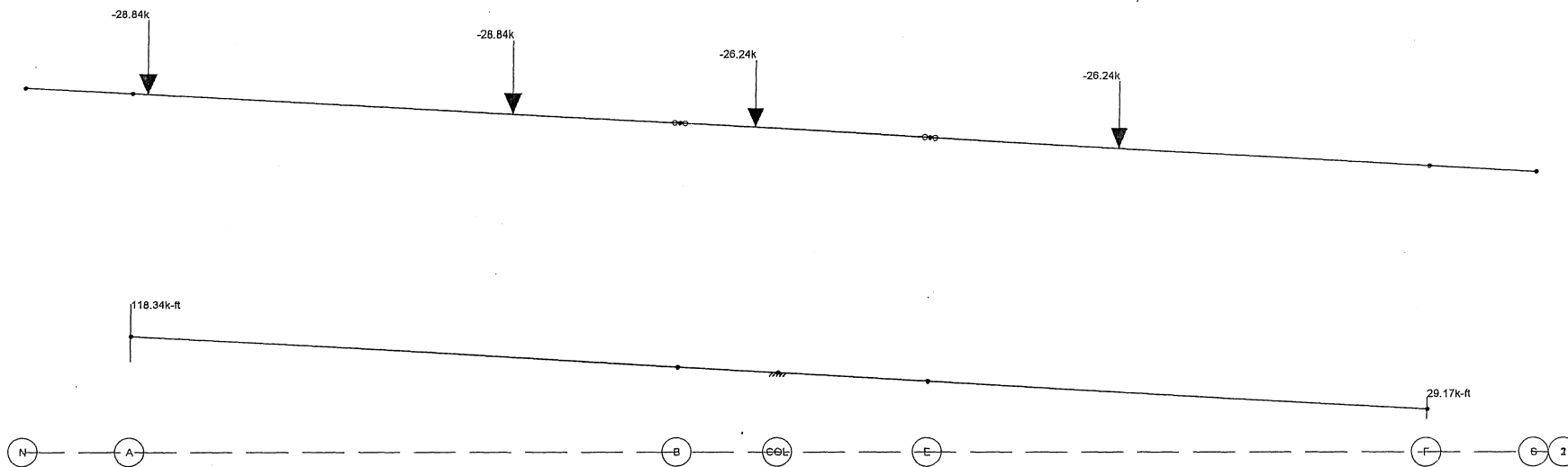
jdf

090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:36 PM

090147_3A_P4_Pier.r3d



Loads: BLC 37, Type 3S3 + SU7 T

LHB

jdf

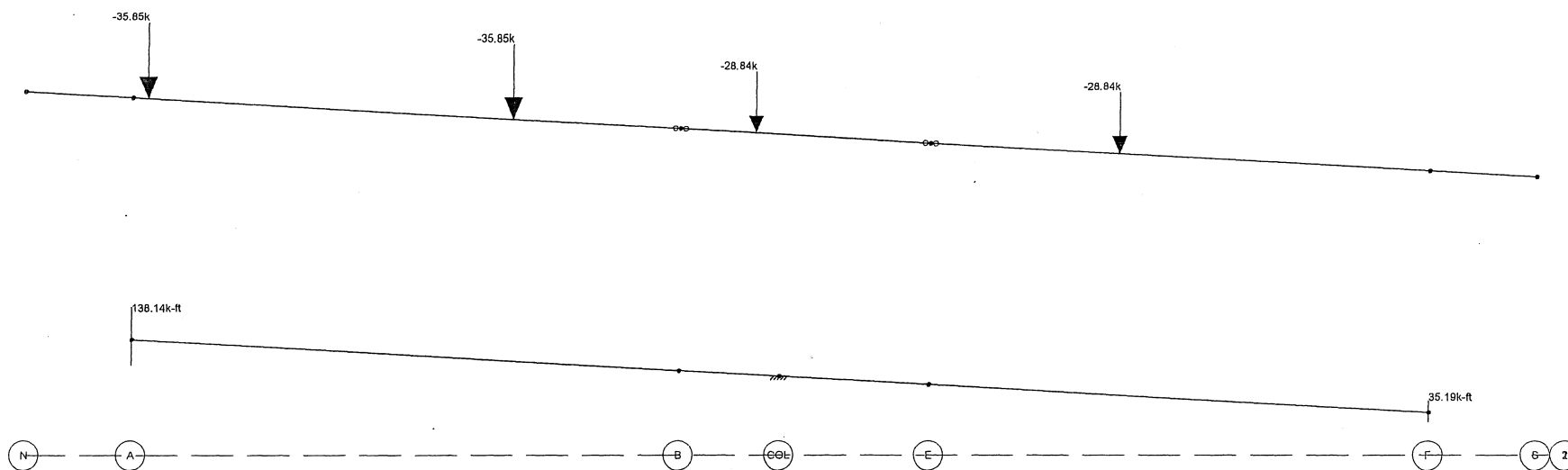
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:36 PM

090147_3A_P4_Pier.r3d

29-7



Loads: BLC 38, Std A + SU7 T

LHB

jdf

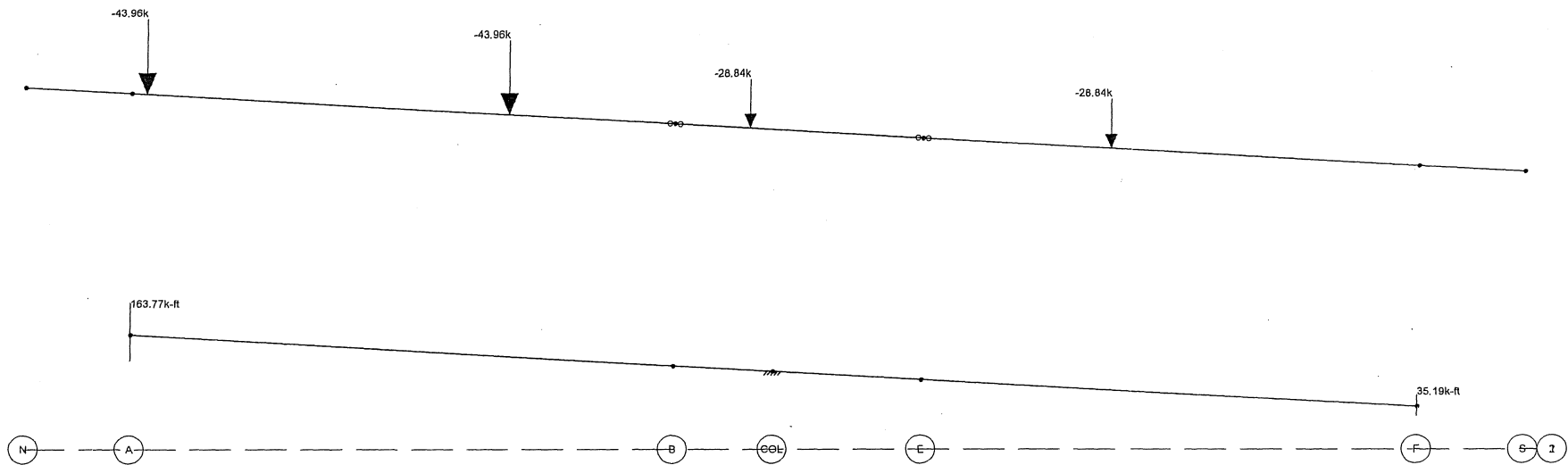
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:36 PM

090147_3A_P4_Pier.r3d

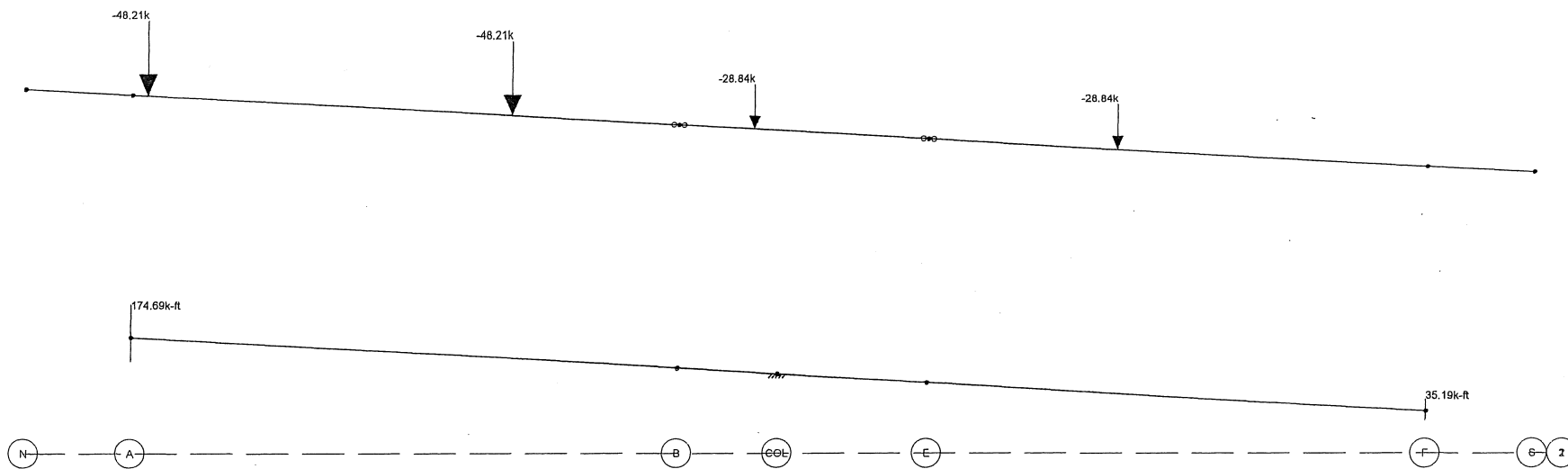
K 101



Loads: BLC 39, Std B + SU7 T

LHB	Bridge 69801 3A Pier 4	
jdf		Apr 19, 2010 at 1:36 PM
090147		090147_3A_P4_Pier.r3d

2-167



Loads: BLC 40, Std C +SU7 T

LHB

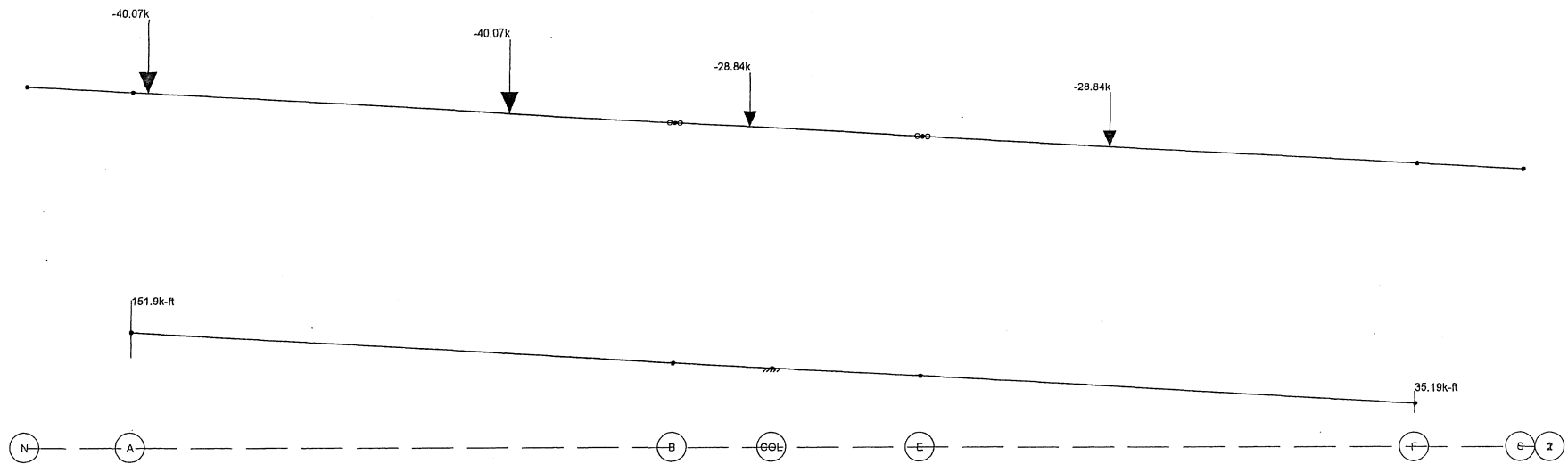
jdf

090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:36 PM

090147_3A_P4_Pier.r3d



Loads: BLC 41, P411 + SU7 T

LHB

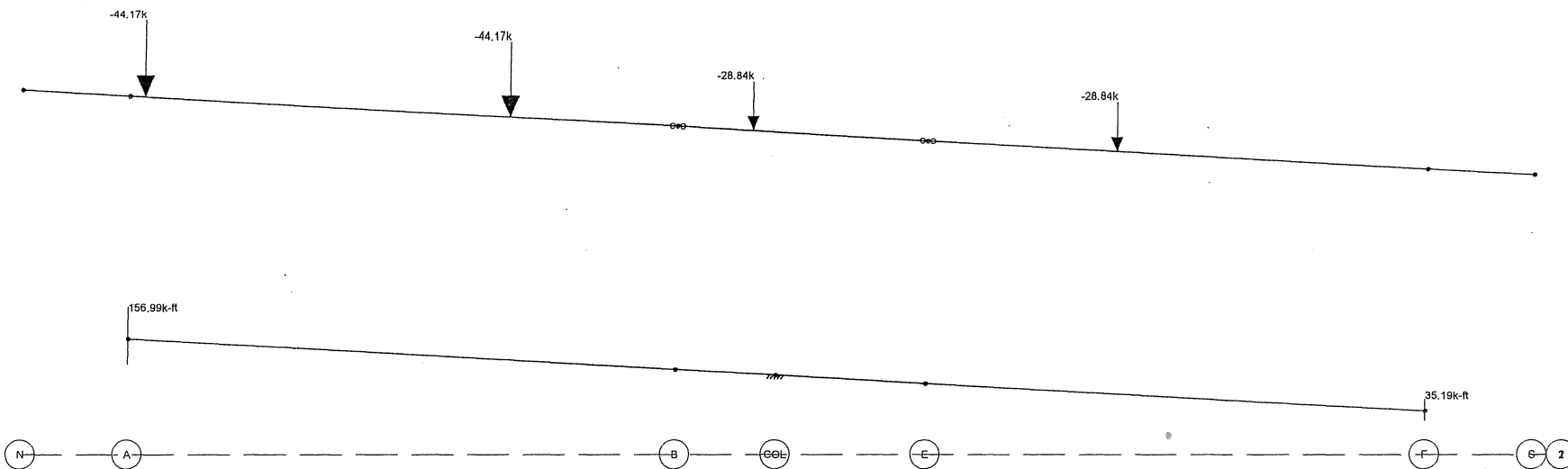
jdf

090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:36 PM

090147_3A_P4_Pier.r3d



Loads: BLC 42, P413 + SU7 T

LHB

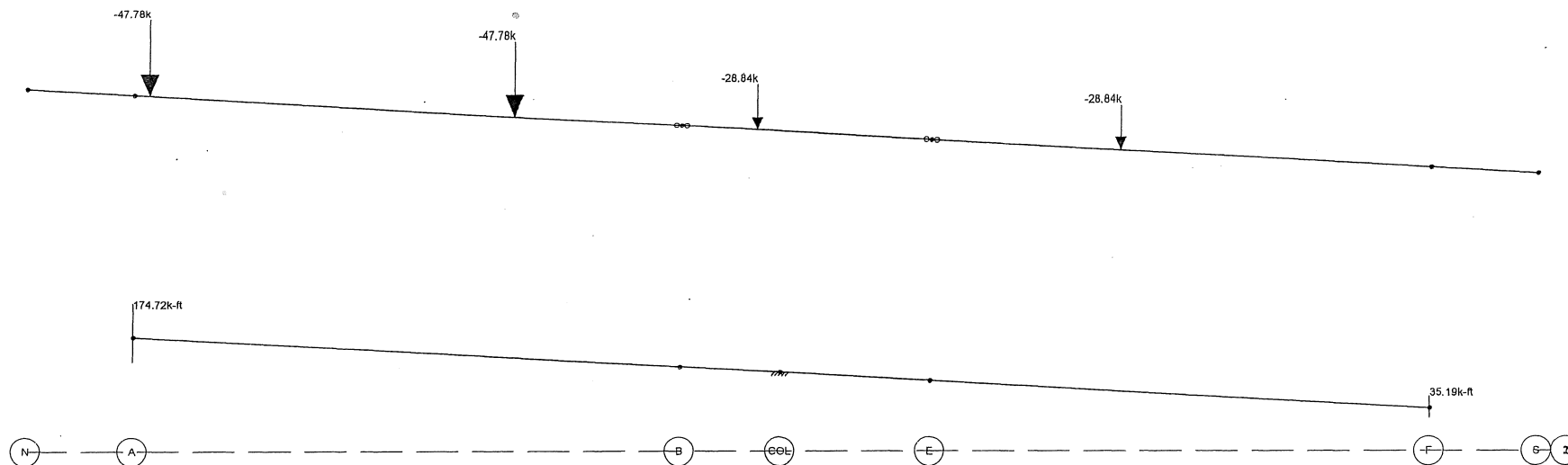
jdf

090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:36 PM

090147_3A_P4_Pier.r3d



Loads: BLC 43, Std C152b + SU7 T

LHB

jdf

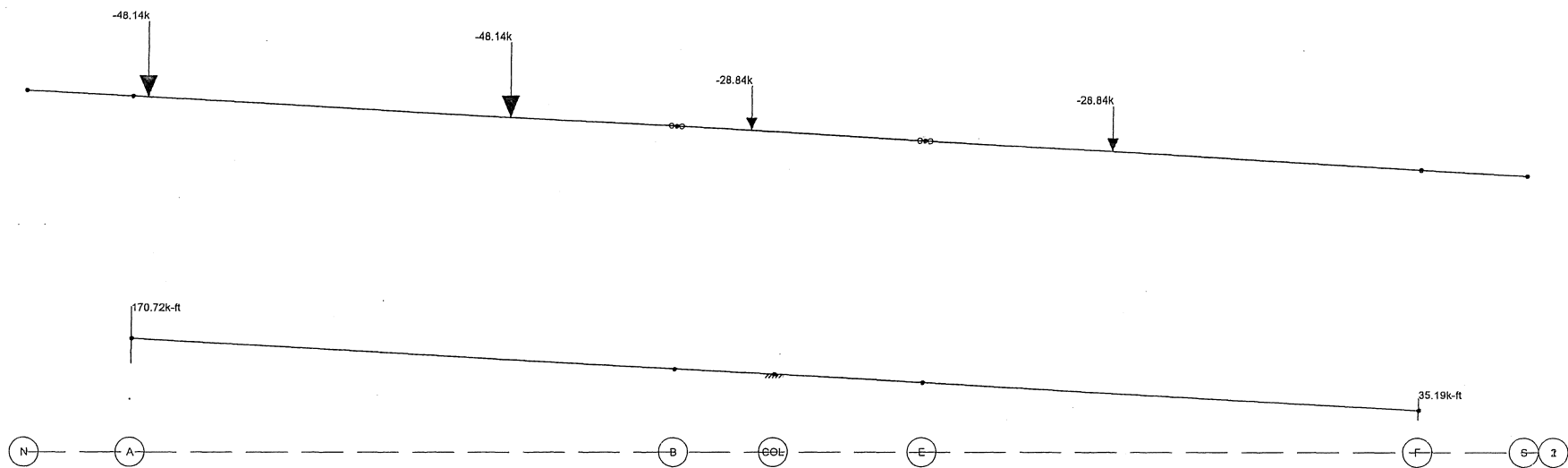
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:36 PM

090147_3A_P4_Pier.r3d

K-66



Loads: BLC 44, Std C174b + SU7 T

LHB

jdf

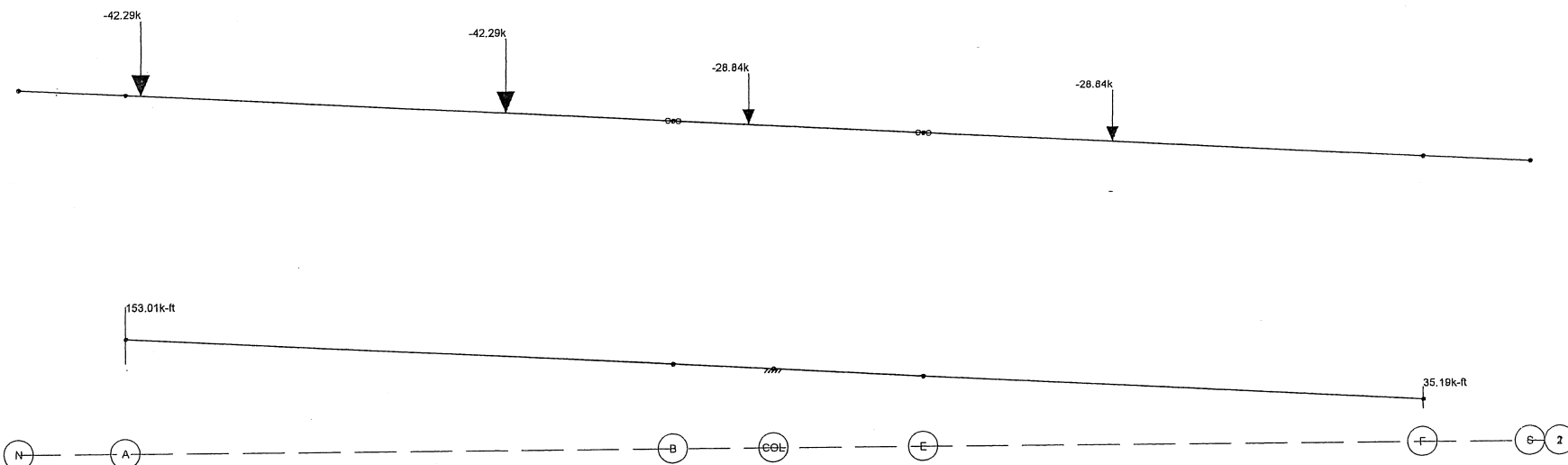
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:36 PM

090147_3A_P4_Pier.r3d

K-67



Loads: BLC 45, Std C198_23 + SU7 T

LHB

jdf

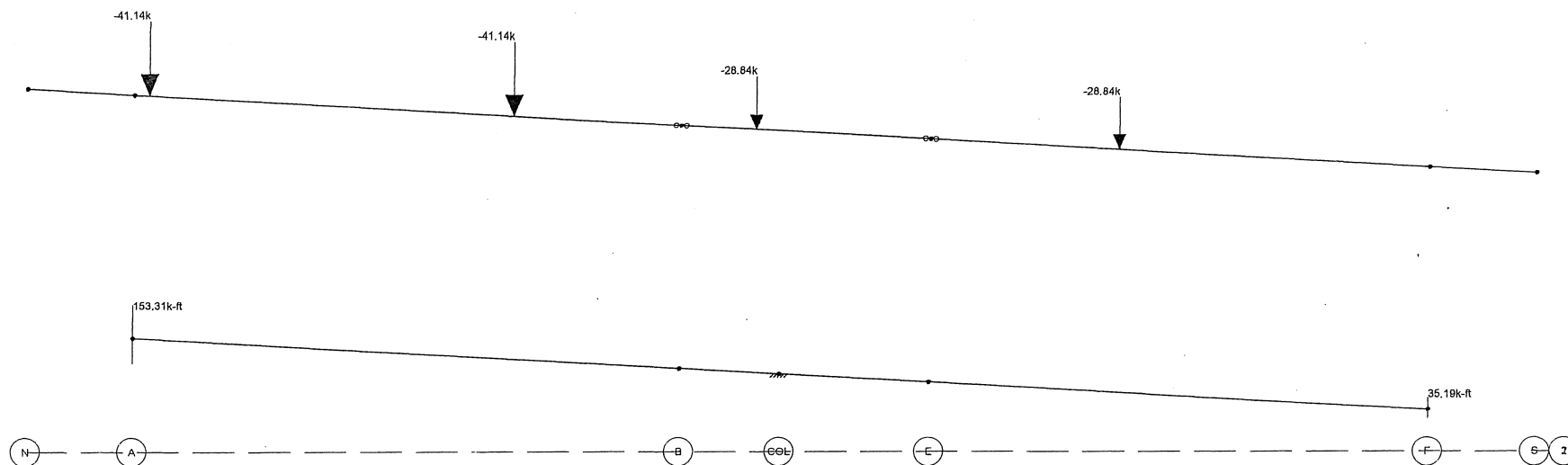
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:36 PM

090147_3A_P4_Pier.r3d

89-7



Loads: BLC 46, Std 214b + SU7 T

LHB

jdf

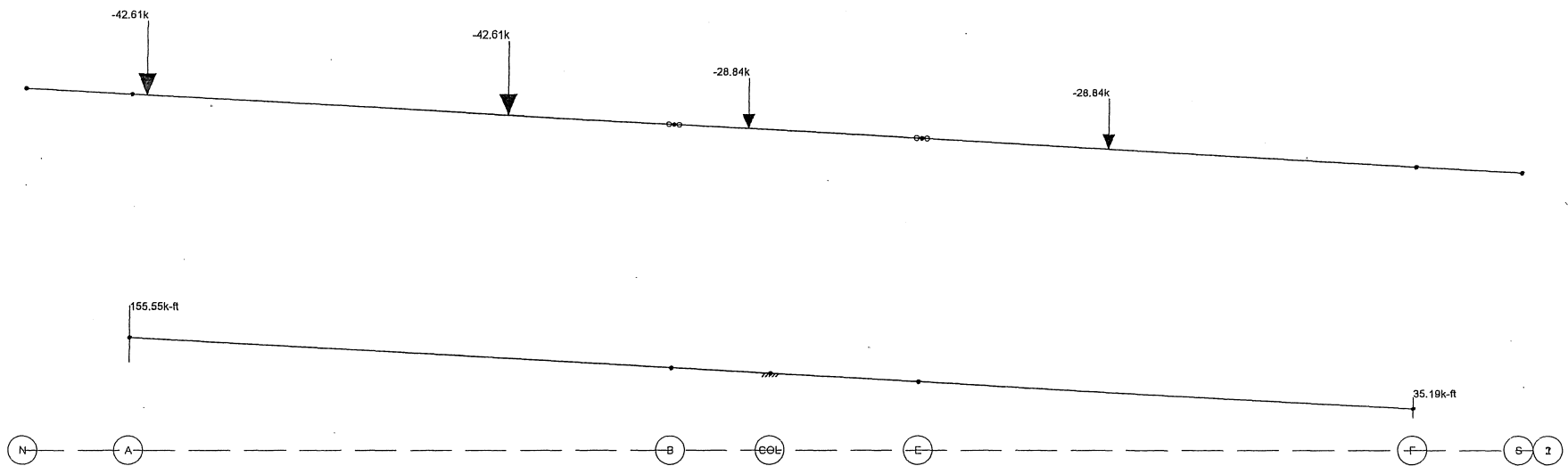
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:37 PM

090147_3A_P4_Pier.r3d

12-69



Loads: BLC 47, Std C237b + SU7 T

LHB

jdf

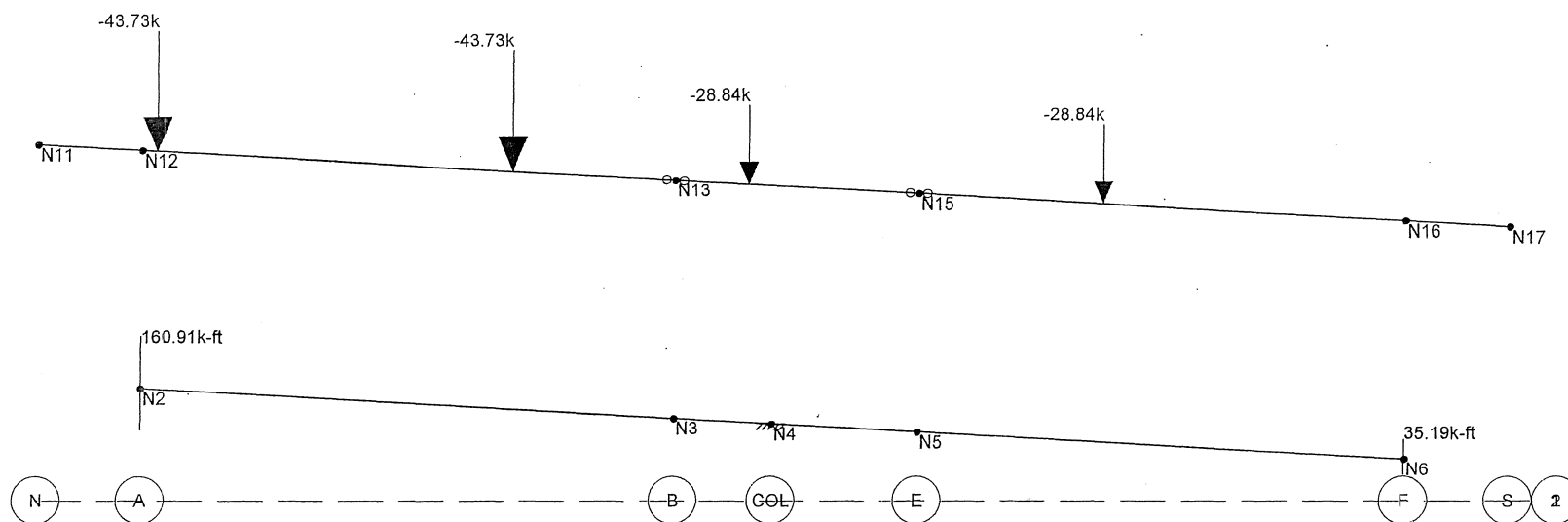
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:37 PM

090147_3A_P4_Pier.r3d

04-71



Loads: BLC 48, Std C256b + SU7 T

LHB

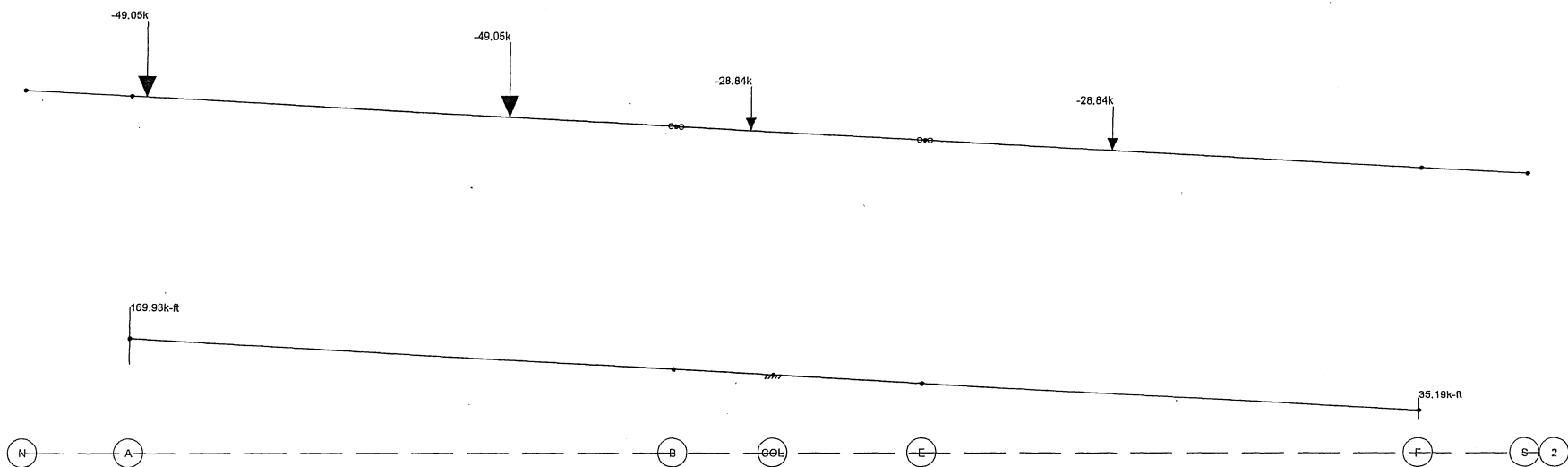
jdf

090147

Bridge 69801 3A Pier 4

Apr 26, 2010 at 11:29 AM

090147_3A_P4_Pier.r3d



Loads: BLC 49, Std C200] + SU7 T

LHB

jdf

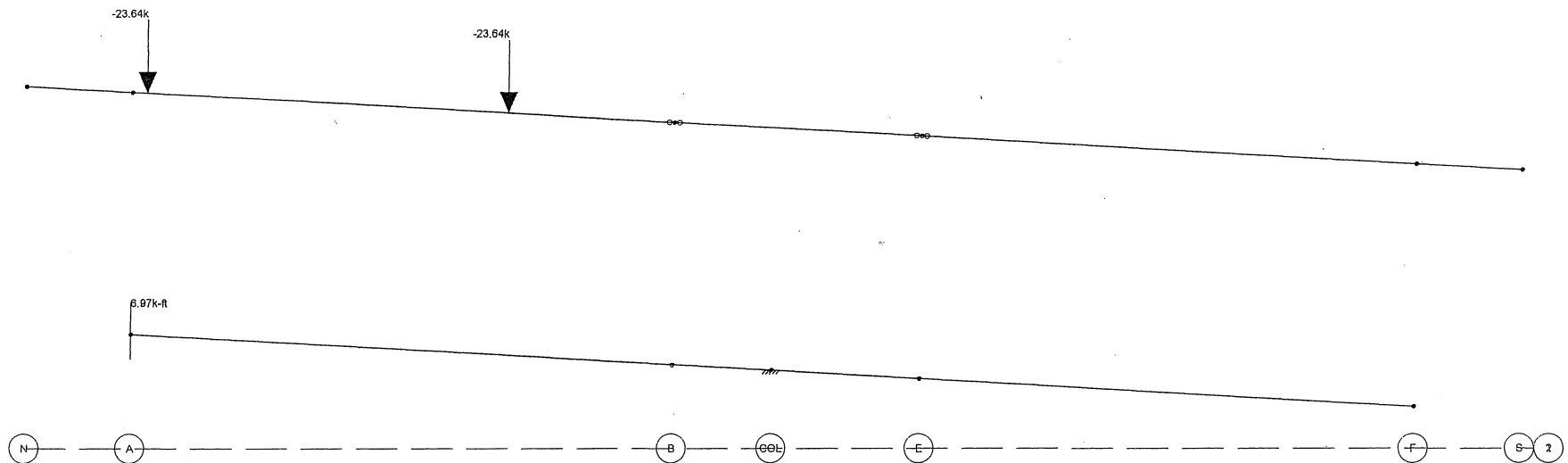
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:37 PM

090147_3A_P4_Pier.r3d

K-72



Loads: BLC 50, Type 3 R

LHB

jdf

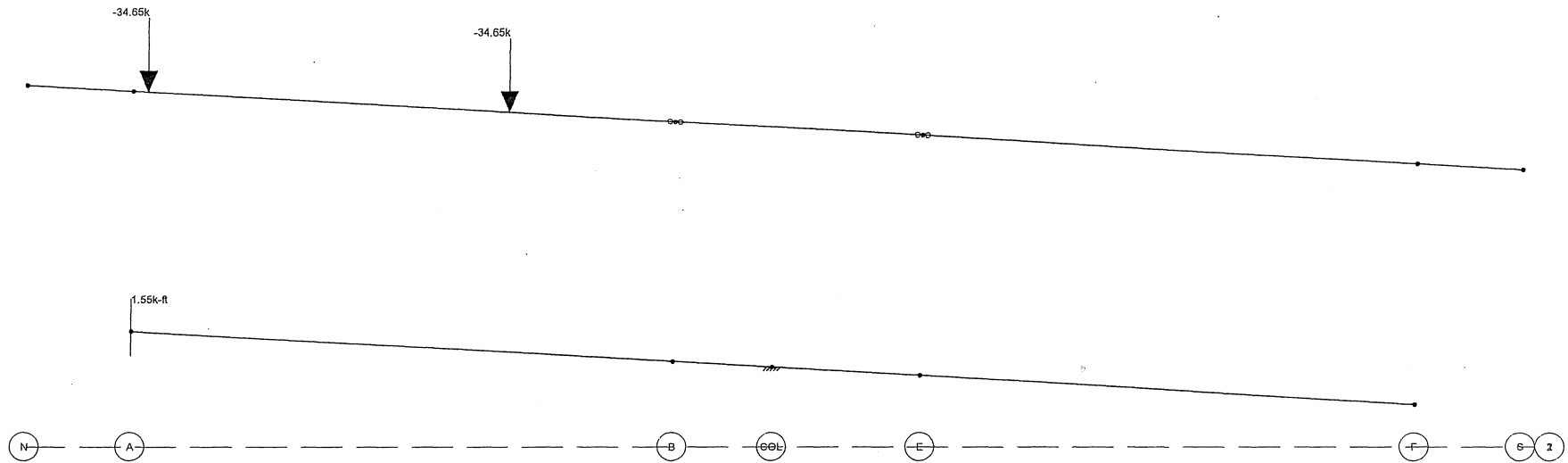
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:37 PM

090147_3A_P4_Pier.r3d

Et-73



Loads: BLC 51, Type 3S2-40 R

LHB

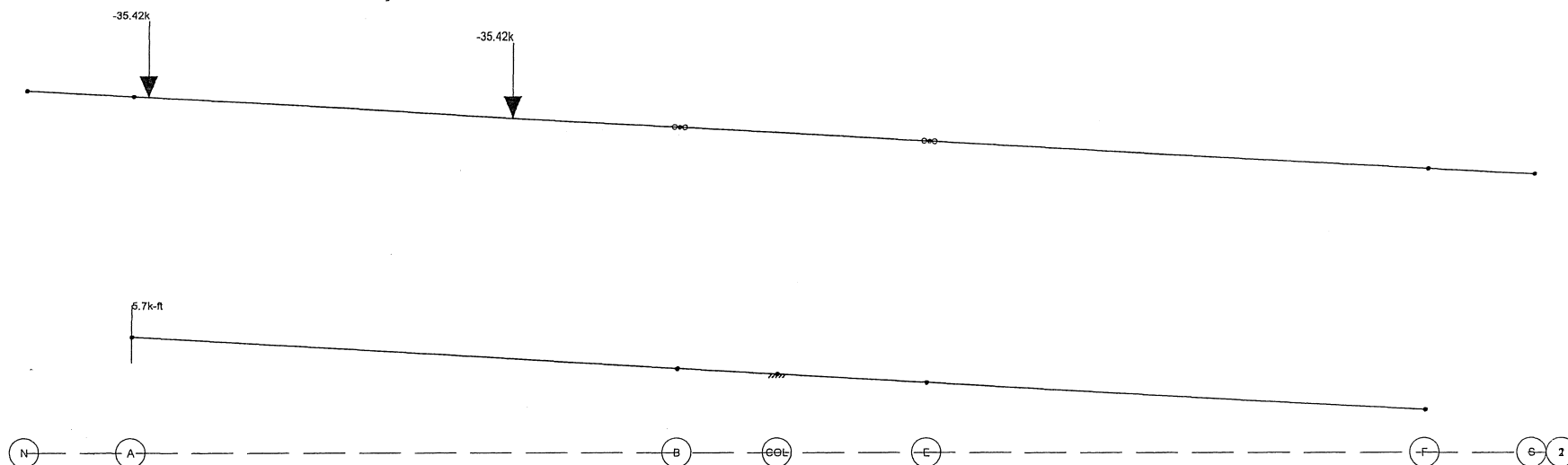
jdf

090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:37 PM

090147_3A_P4_Pier.r3d



Loads: BLC 52, Type 3S3 R

LHB

jdf

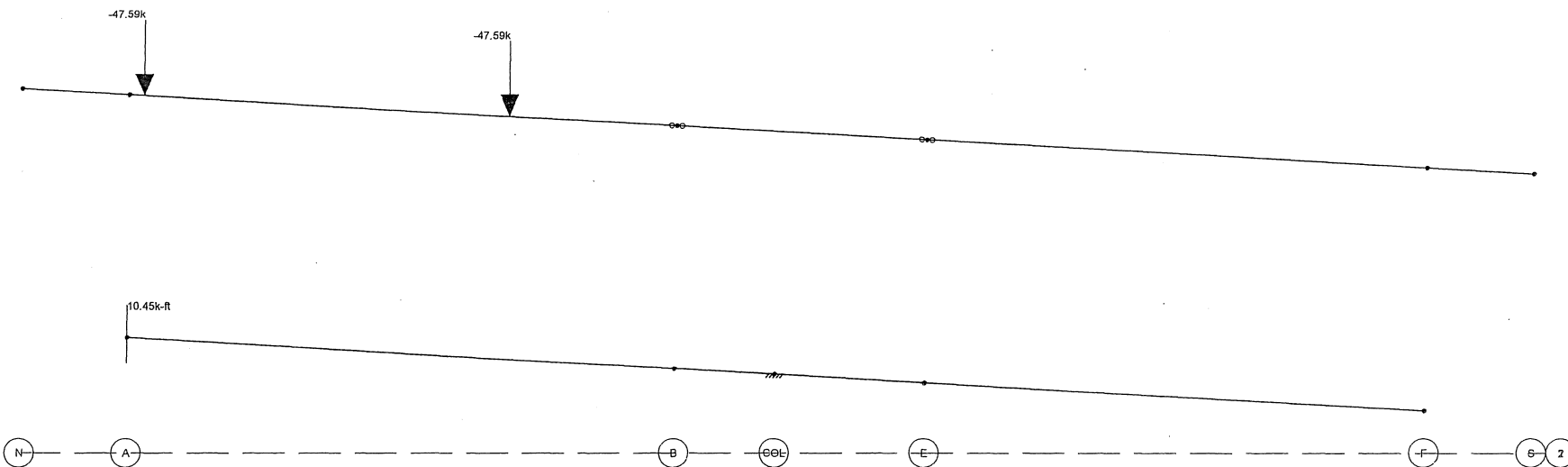
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:37 PM

090147_3A_P4_Pier.r3d

K-75



Loads: BLC 53, Std A R

LHB

jdf

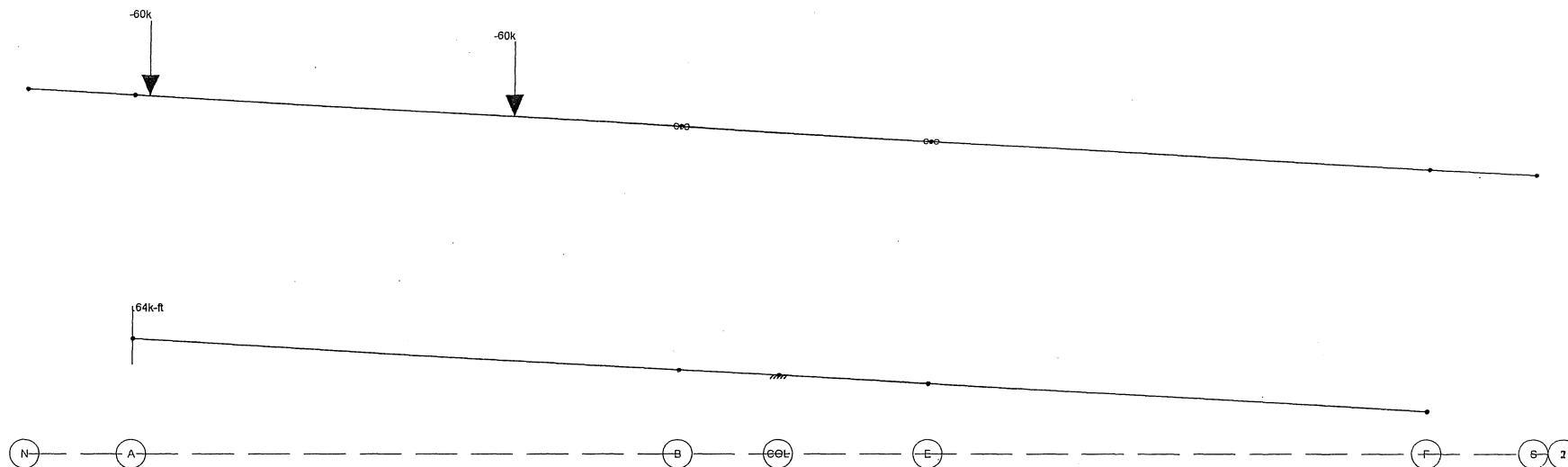
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:37 PM

090147_3A_P4_Pier.r3d

K-76



Loads: BLC 54, Std B R

LHB

jdf

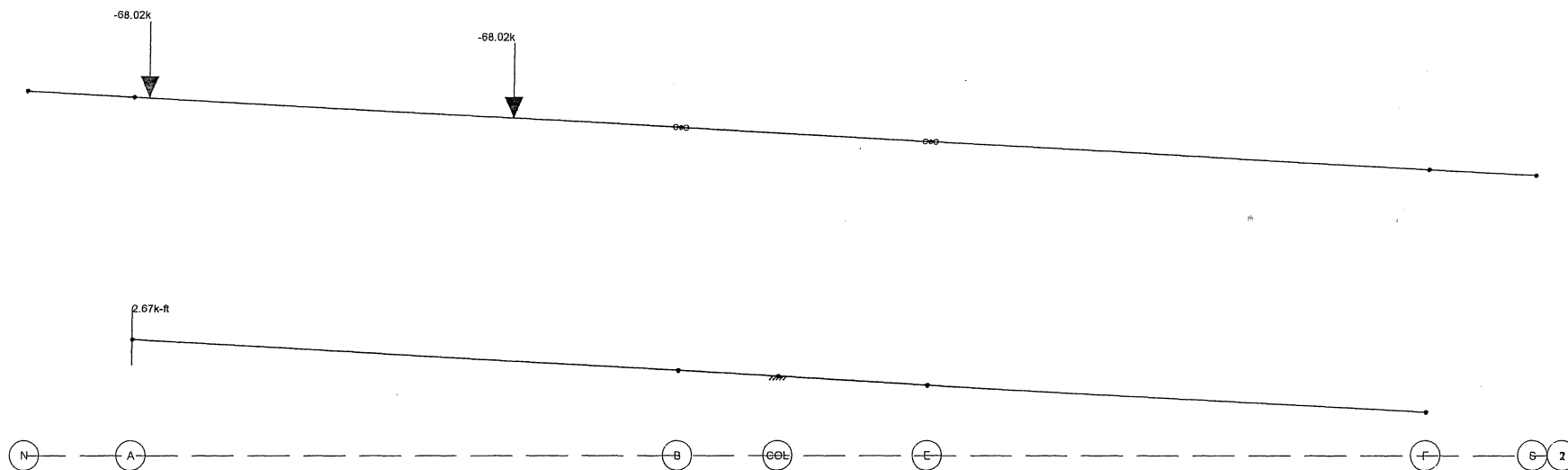
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:37 PM

090147_3A_P4_Pier.r3d

1K-77



Loads: BLC 55, Std C R

LHB

jdf

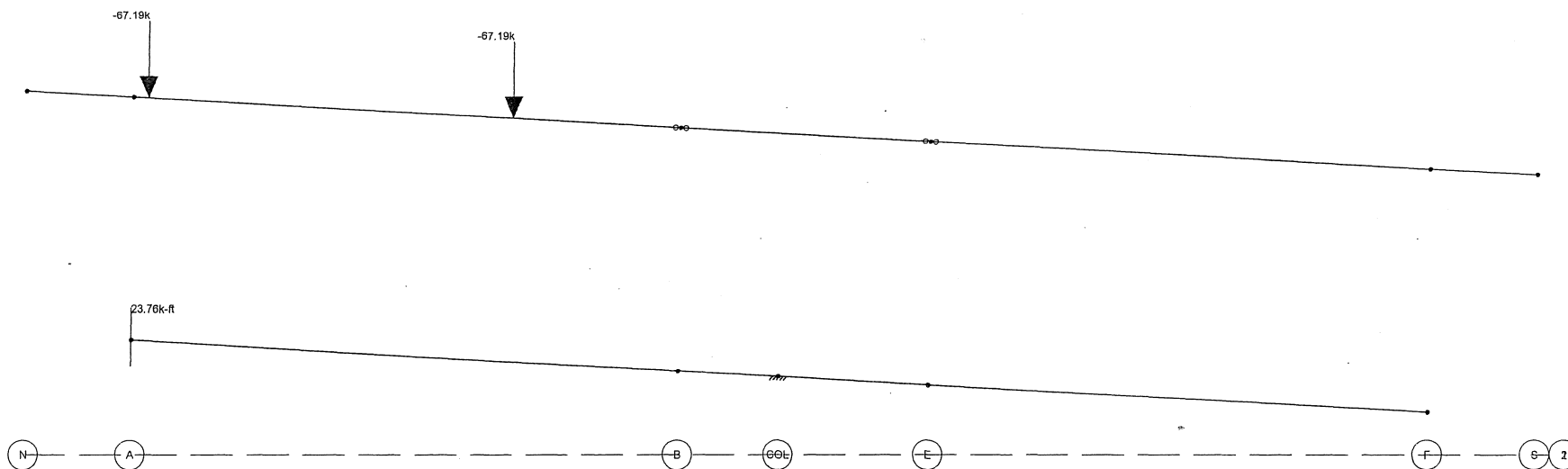
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:37 PM

090147_3A_P4_Pier.r3d

8-78



Loads: BLC 56, P411 R

LHB

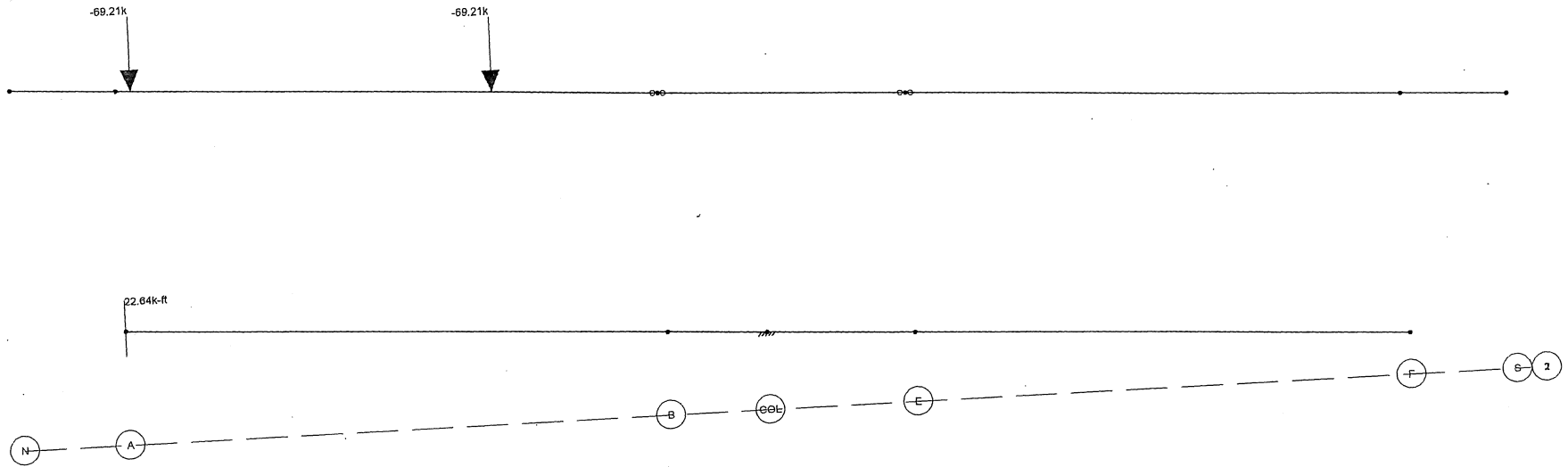
jdf

090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:37 PM

090147_3A_P4_Pier.r3d



Loads: BLC 57, P413 R

LHB

jdf

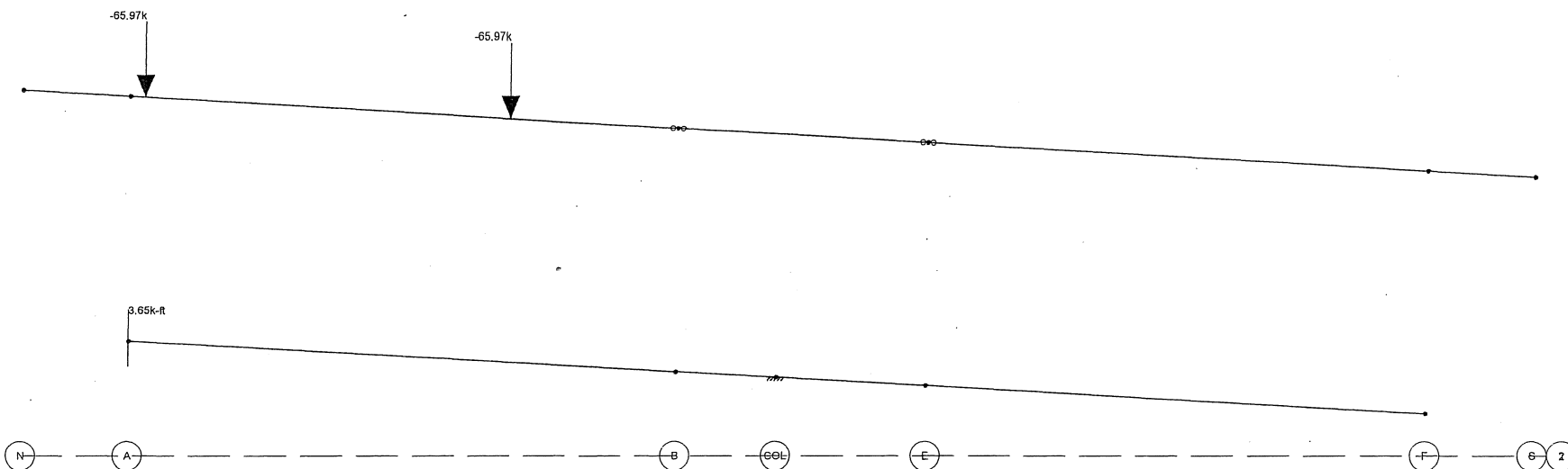
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:38 PM

090147_3A_P4_Pier.r3d

K-80



Loads: BLC 58, Std C152b R

LHB

jdf

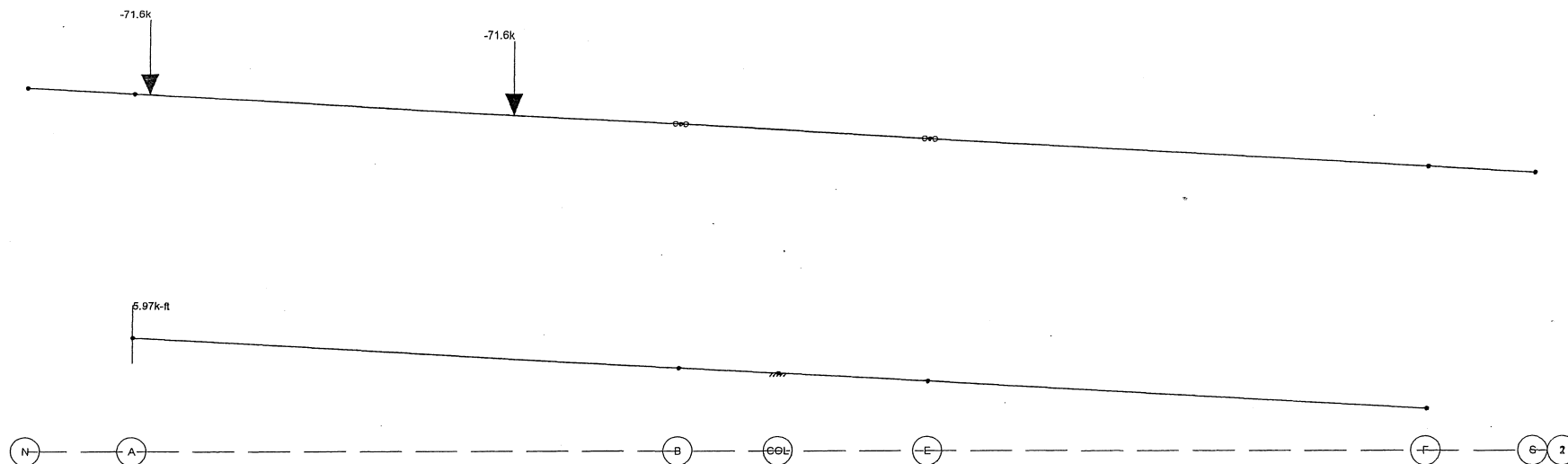
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:38 PM

090147_3A_P4_Pier.r3d

18-7



Loads: BLC 59, Std C174b R

LHB

jdf

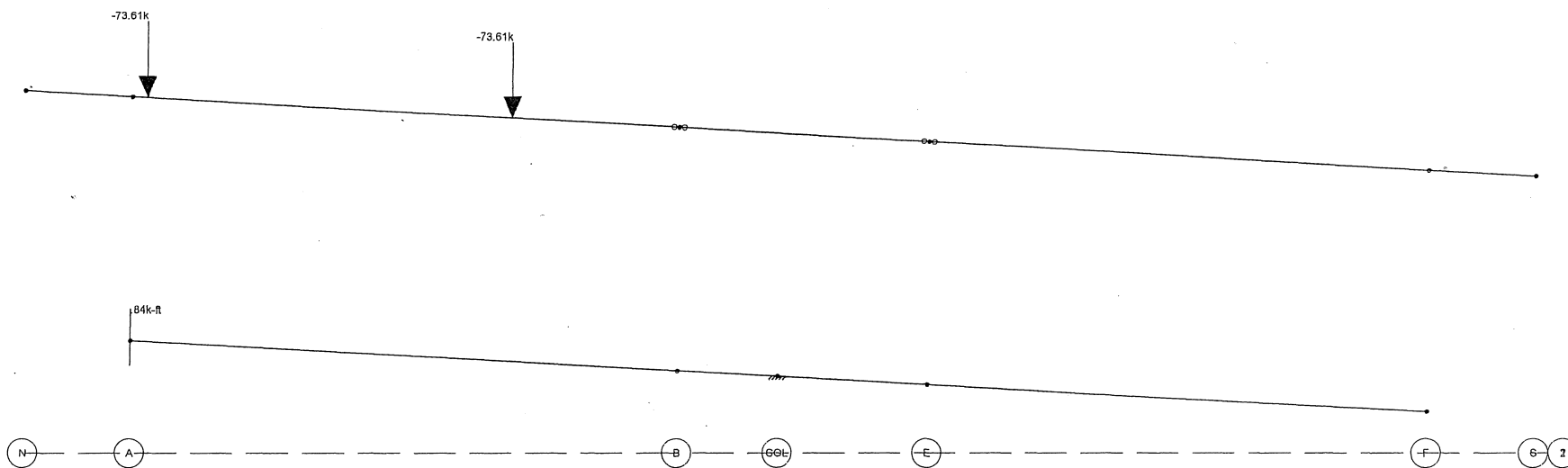
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:38 PM

090147_3A_P4_Pier.r3d

K-82



Loads: BLC 60, Std C198_23 R

LHB

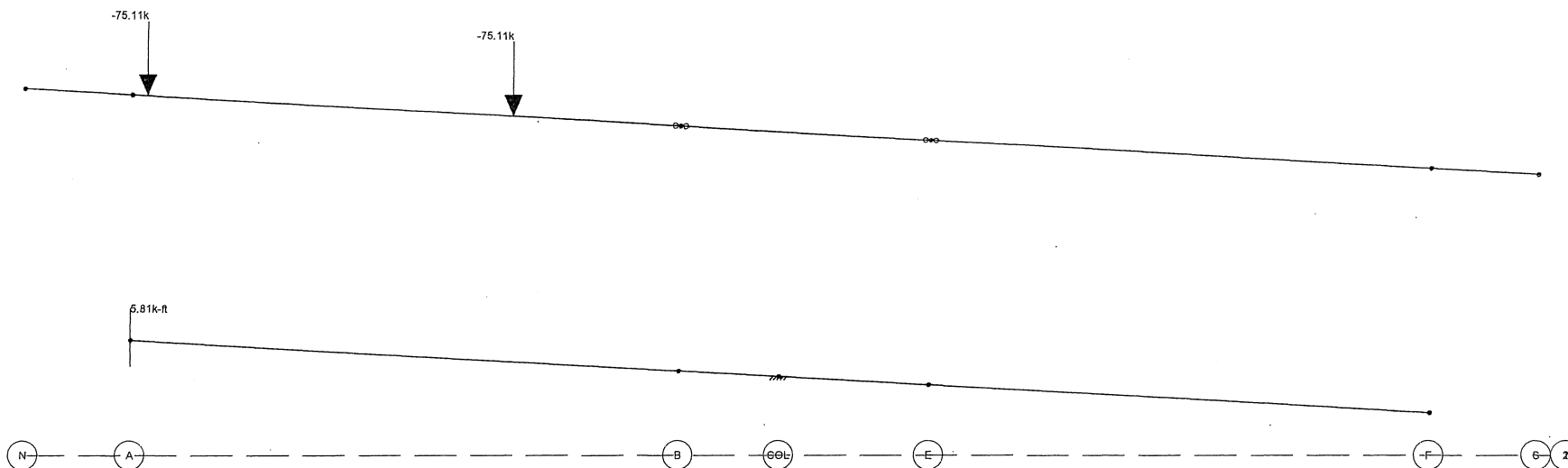
jdf

090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:38 PM

090147_3A_P4_Pier.r3d



Loads: BLC 61, Std 214b R

LHB

jdf

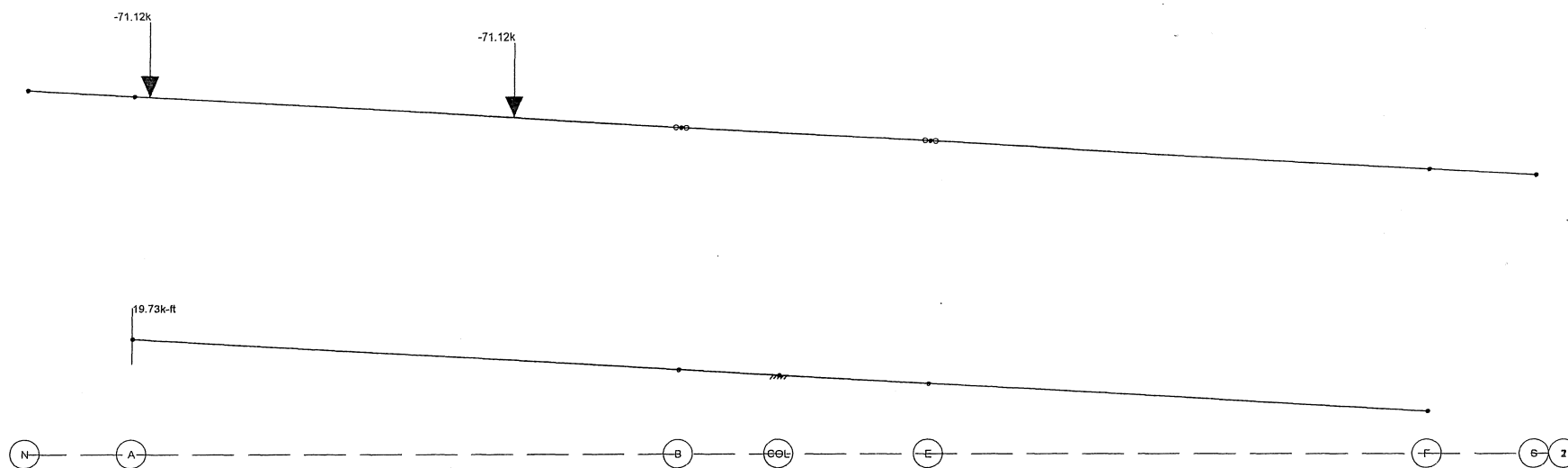
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:38 PM

090147_3A_P4_Pier.r3d

78-84



Loads: BLC 62, Std C237b R

LHB

jdf

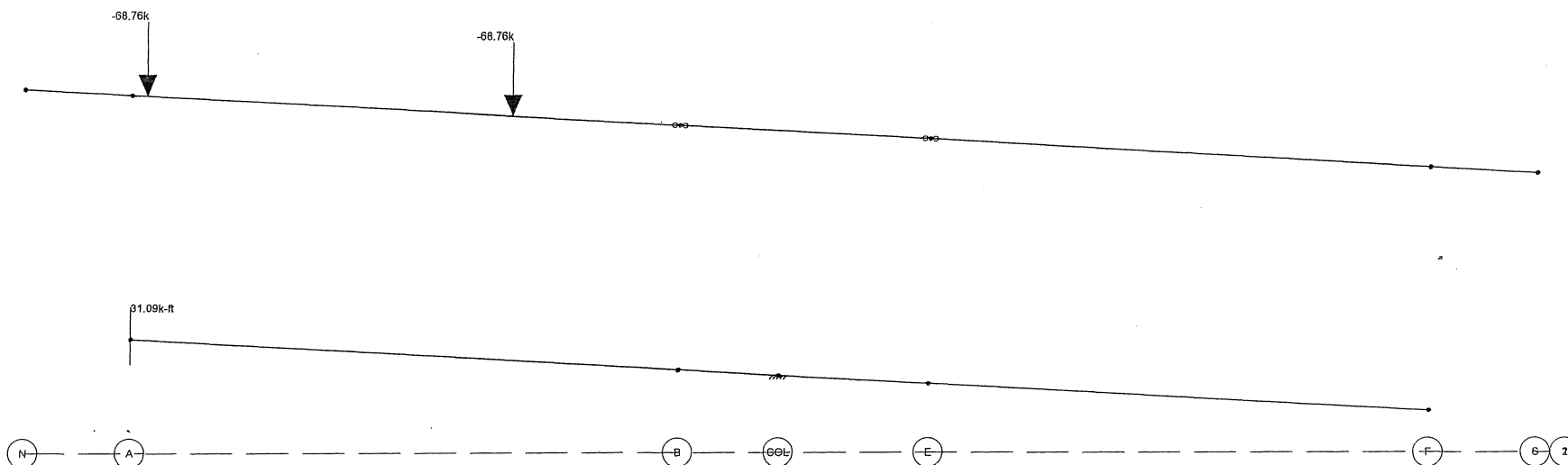
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:38 PM

090147_3A_P4_Pier.r3d

K-85



Loads: BLC 63, Std C256b R

LHB

jdf

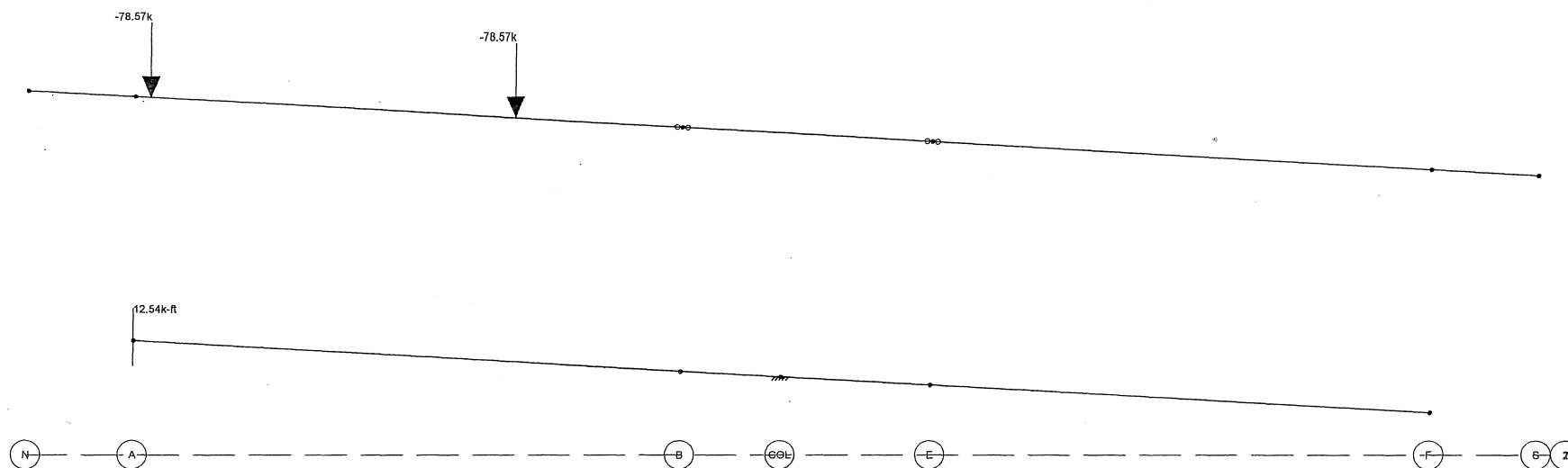
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:38 PM

090147_3A_P4_Pier.r3d

98-7



Loads: BLC 64, Std C200J R

LHB

jdf

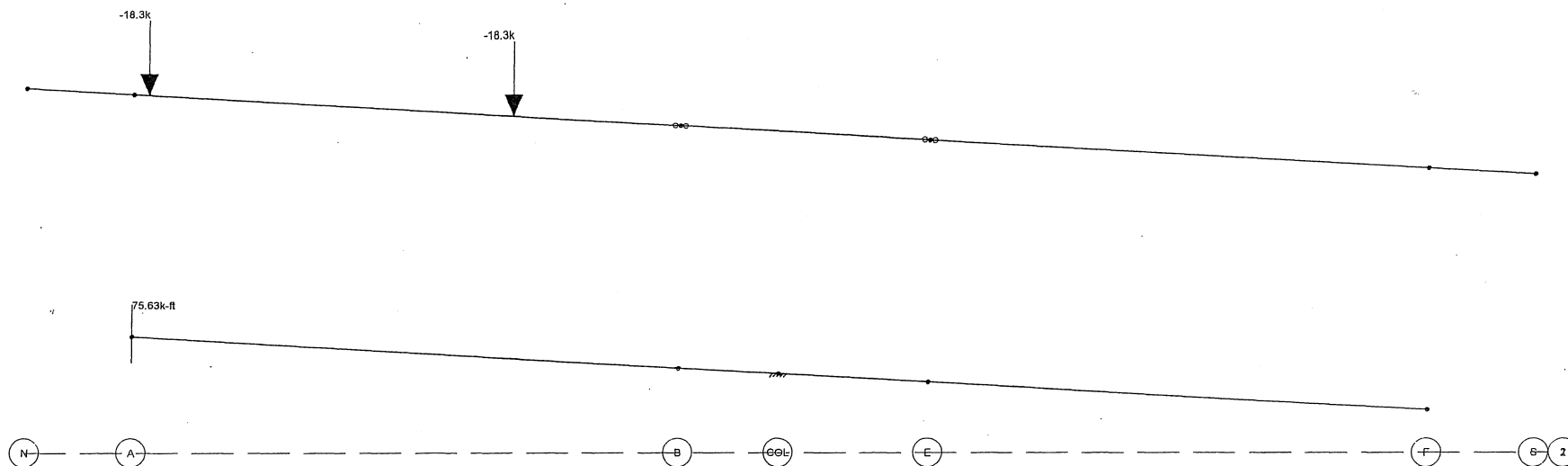
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:38 PM

090147_3A_P4_Pier.r3d

K-87



Loads: BLC 85, Type 3 T

LHB

jdf

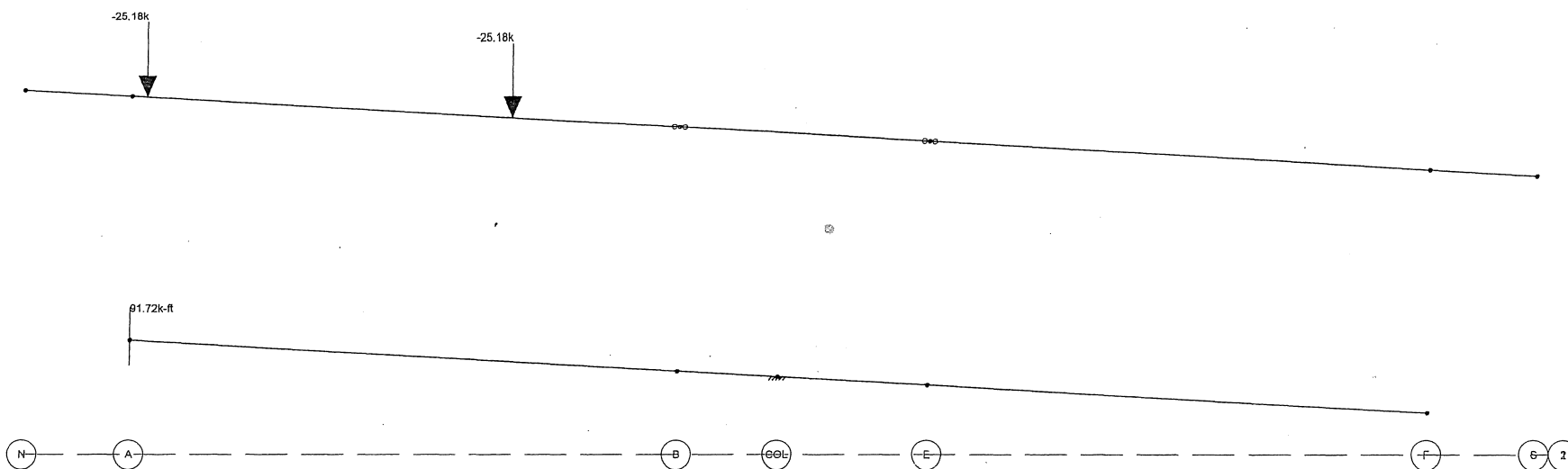
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:38 PM

090147_3A_P4_Pier.r3d

K-88



Loads: BLC 66, Type 3S2-40 T

LHB

jdf

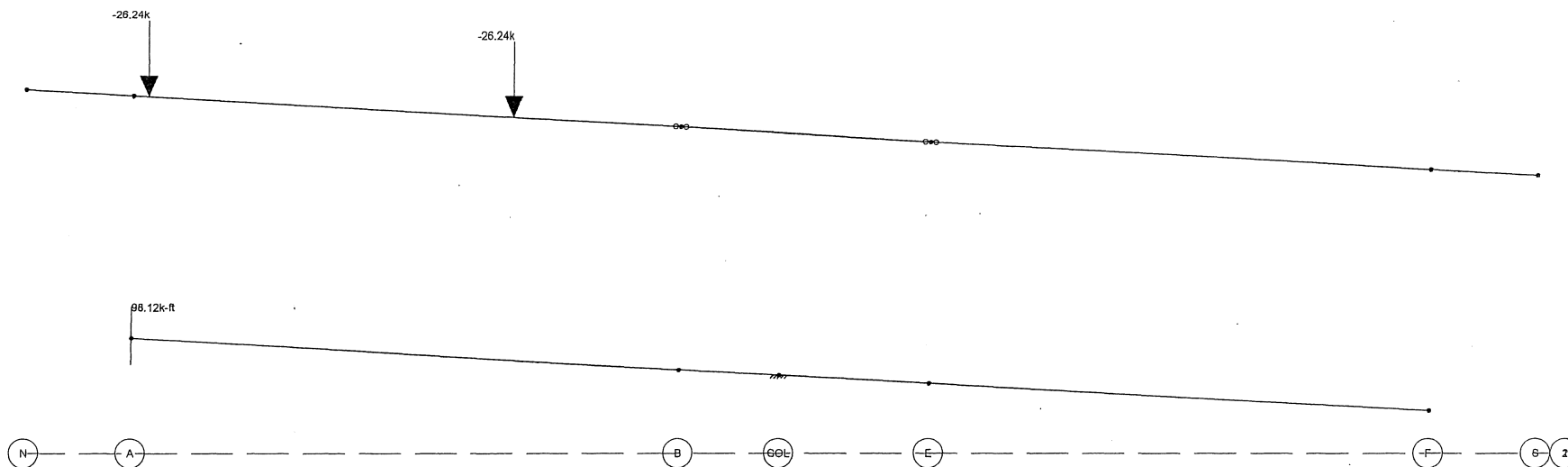
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:38 PM

090147_3A_P4_Pier.r3d

1C-89



Loads: BLC 67, Type 3S3 T

LHB

jdf

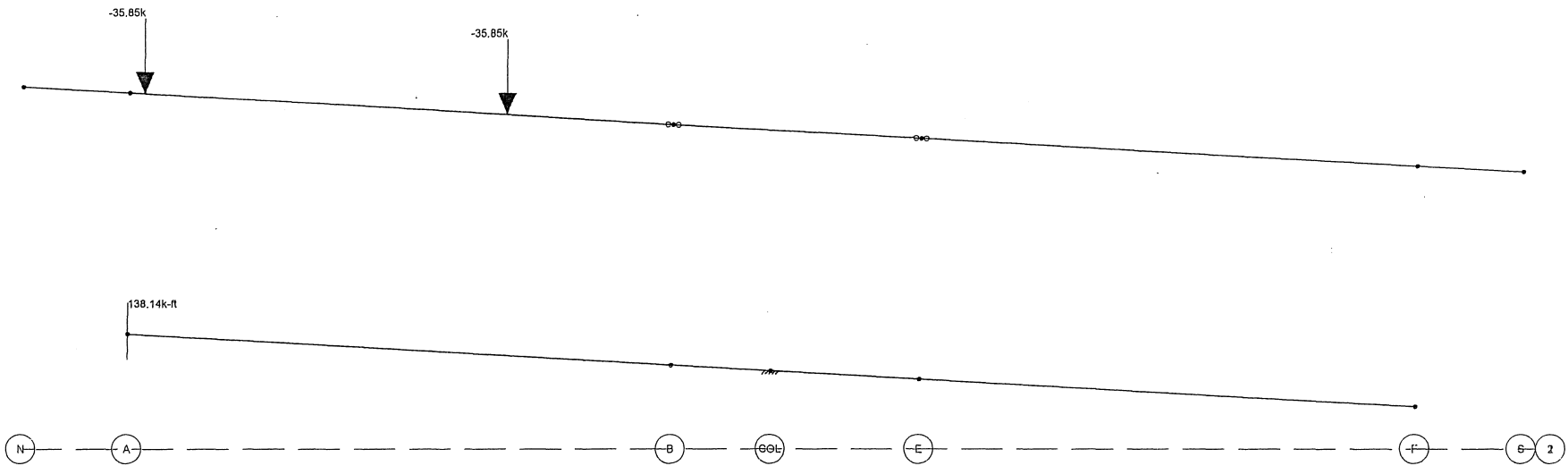
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:39 PM

090147_3A_P4_Pier.r3d

K-90



Loads: BLC 68, Std A T

LHB

jdf

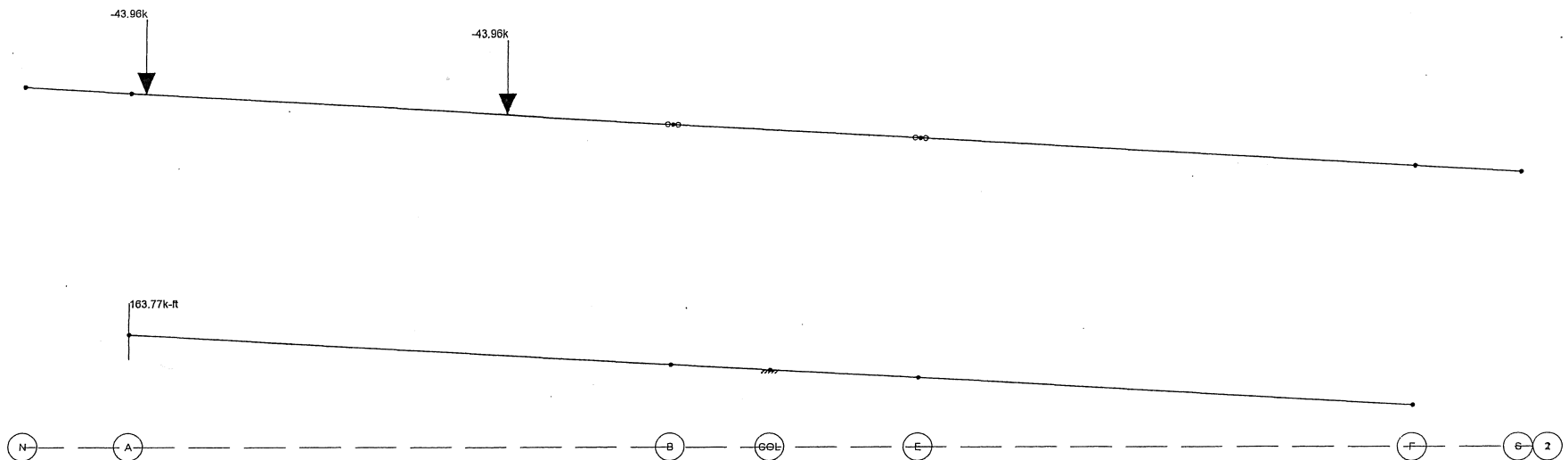
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:39 PM

090147_3A_P4_Pier.r3d

K-91



Loads: BLC 69, Std B T

LHB

jdf

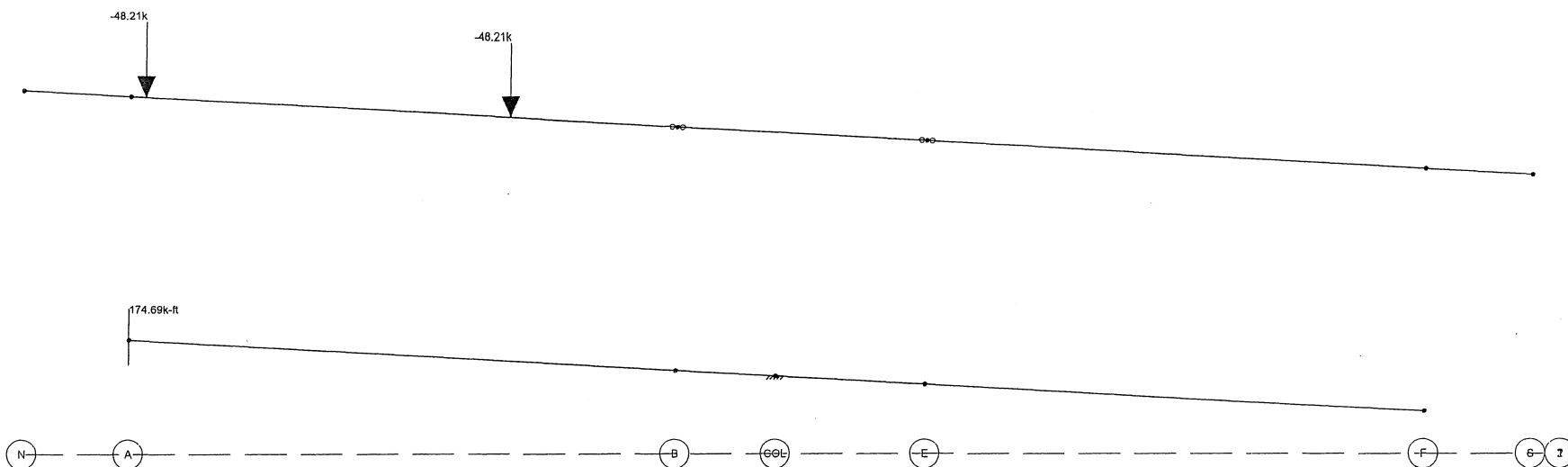
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:39 PM

090147_3A_P4_Pier.r3d

1C-92



Loads: BLC 70, Std C T

LHB

jdf

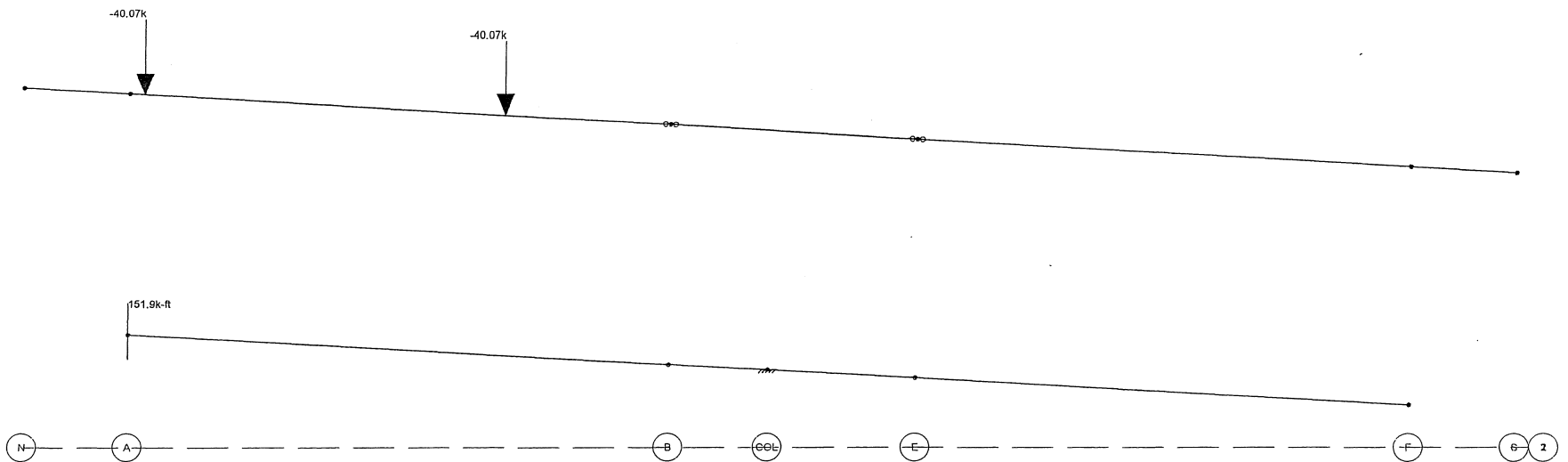
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:39 PM

090147_3A_P4_Pier.r3d

K-93



Loads: BLC 71, P411 T

LHB

jdf

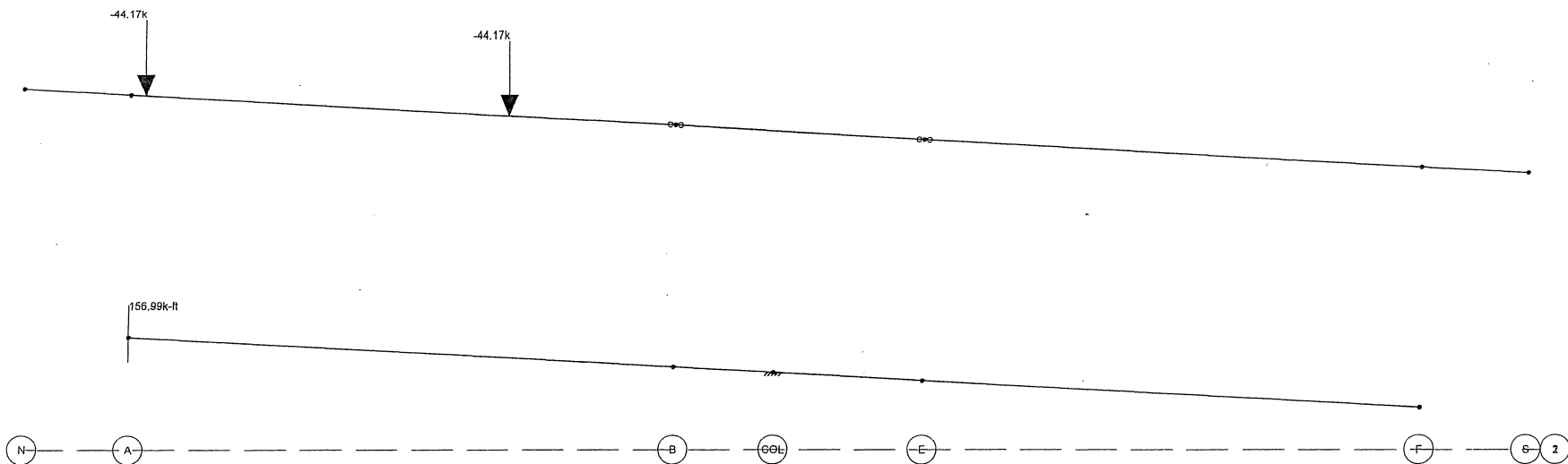
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:39 PM

090147_3A_P4_Pier.r3d

K-94



Loads: BLC 72, P413 T

LHB

jdf

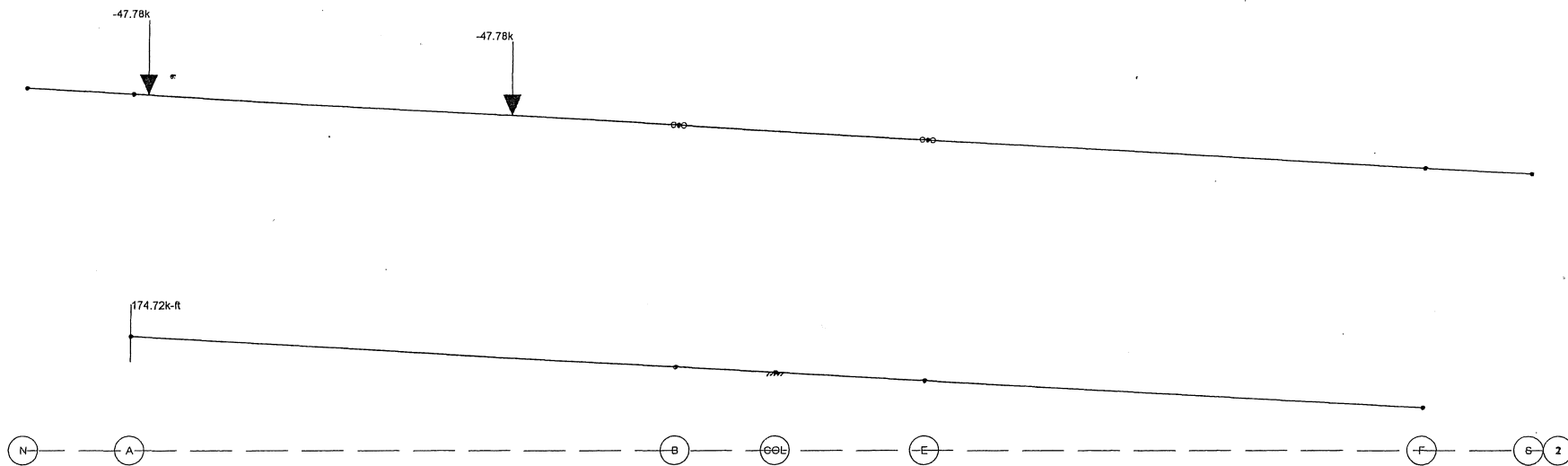
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:39 PM

090147_3A_P4_Pier.r3d

K-95



Loads: BLC 73, Std C152b T

LHB

jdf

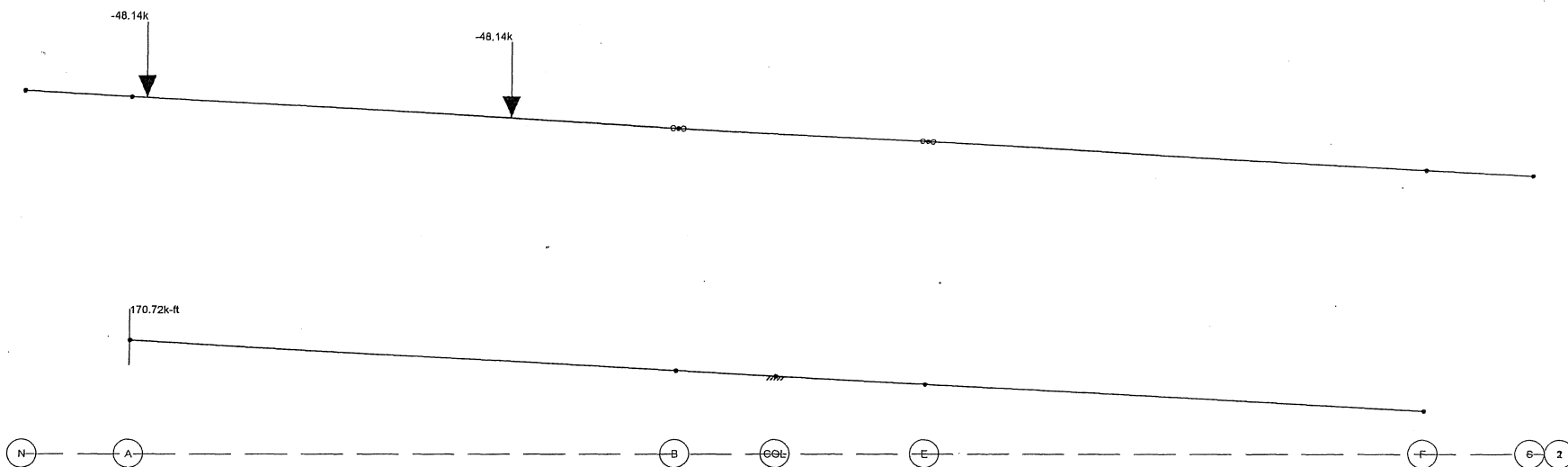
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:39 PM

090147_3A_P4_Pier.r3d

1c-96



Loads: BLC 74, Std C174b T

LHB

jdf

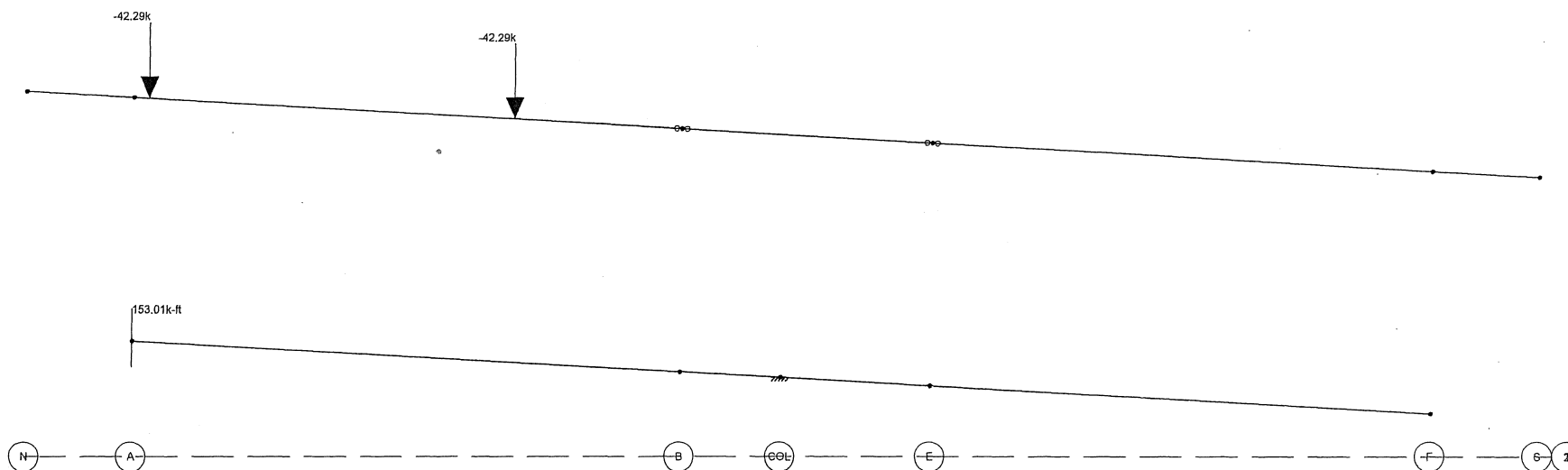
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:39 PM

090147_3A_P4_Pier.r3d

K-97



Loads: BLC 75, Std C198_23 T

LHB

jdf

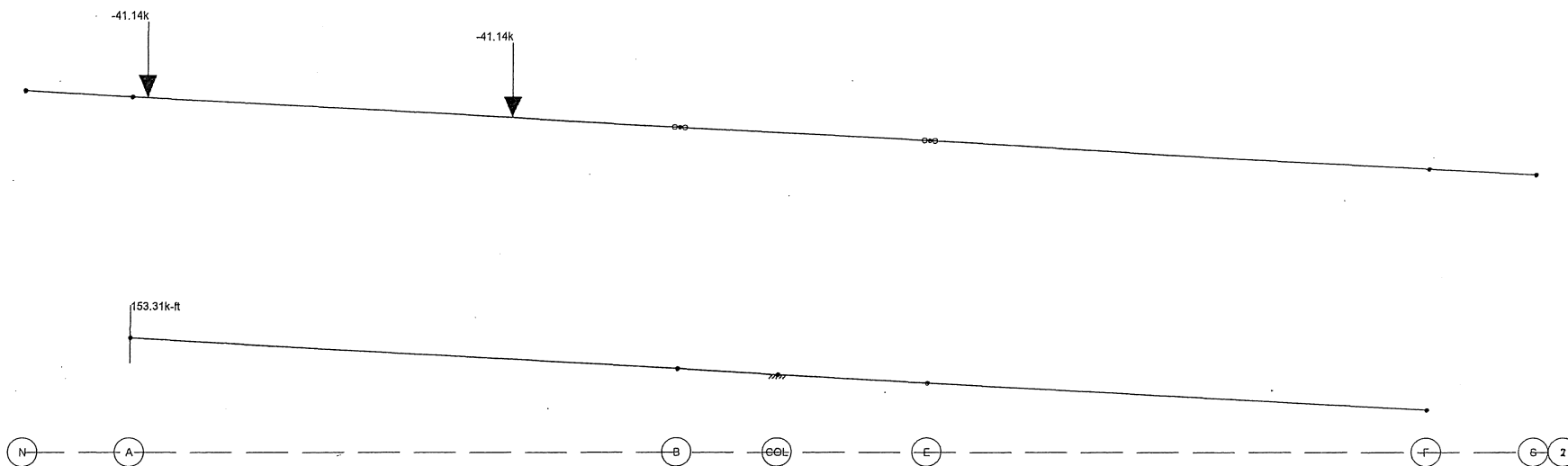
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:39 PM

090147_3A_P4_Pier.r3d

86-71



Loads: BLC 76, Std 214b T

LHB

jdf

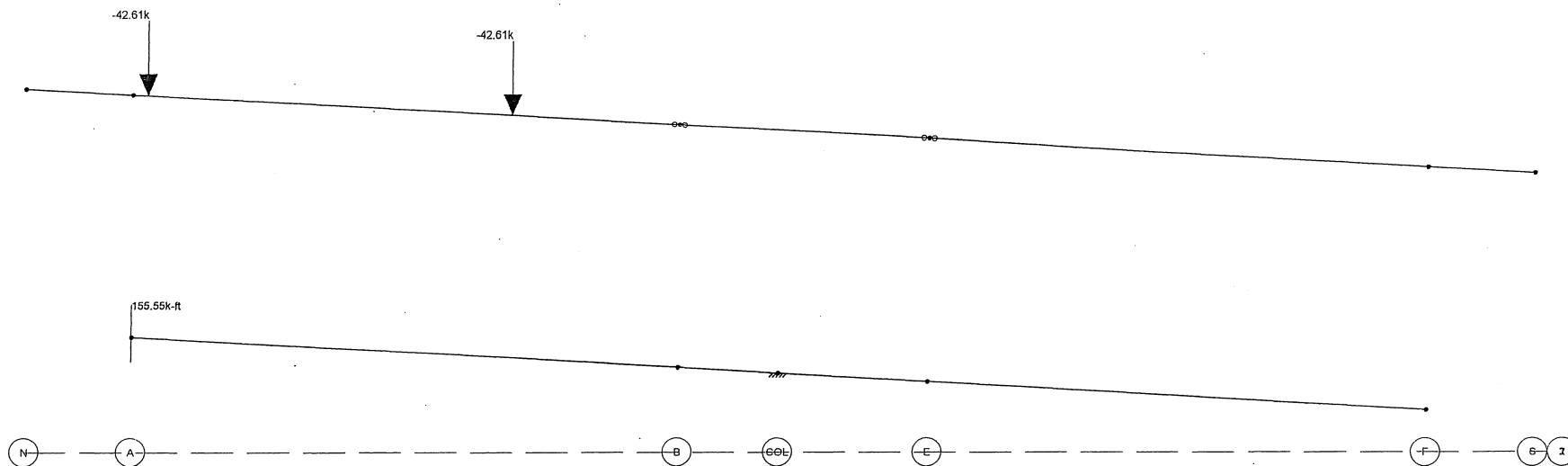
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:39 PM

090147_3A_P4_Pier.r3d

66-99



Loads: BLC 77, Std C237b T

LHB

jdf

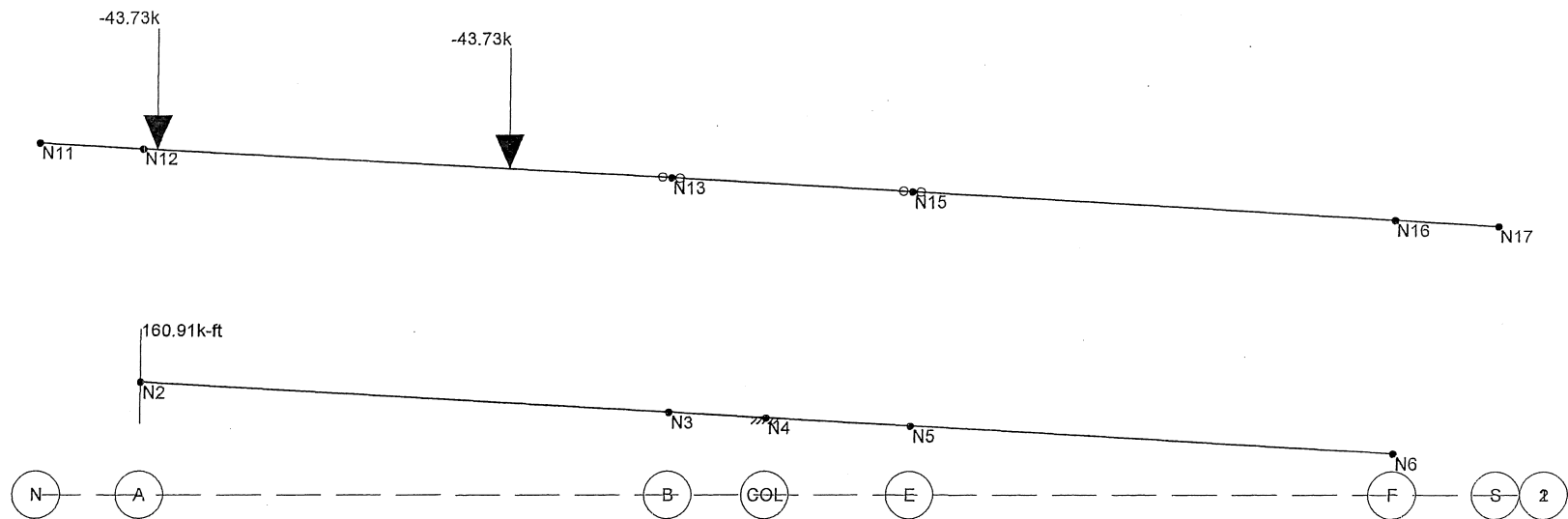
090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:39 PM

090147_3A_P4_Pier.r3d

K-100



Loads: BLC 78, Std C256b T

LHB

jdf

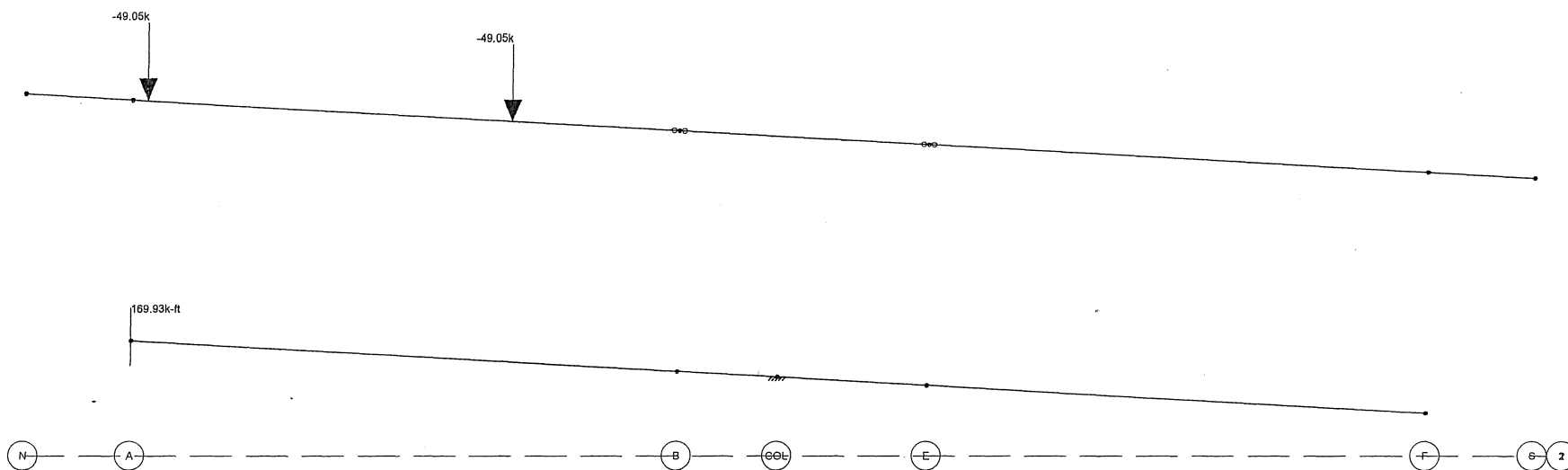
090147

Bridge 69801 3A Pier 4

Apr 26, 2010 at 11:29 AM

090147_3A_P4_Pier.r3d

K-101



Loads: BLC 79, Std C200j T

LHB

jdf

090147

Bridge 69801 3A Pier 4

Apr 19, 2010 at 1:40 PM

090147_3A_P4_Pier.r3d

K-102

698013-24-94
MODEL RESULTS

Beam: **M1**

Shape: **BR3A-4a-RevisedJ**

Material: **A36 Steel**

Length: **21.353 ft**

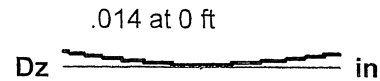
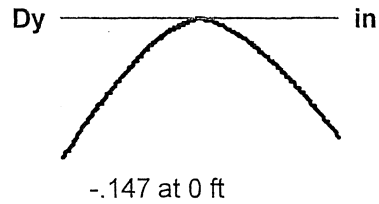
I Joint: **N2**

J Joint: **N6**

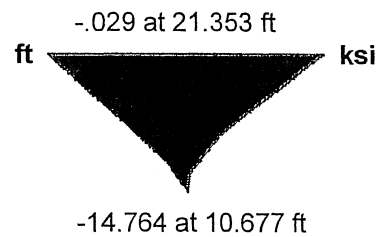
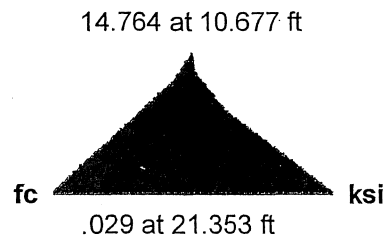
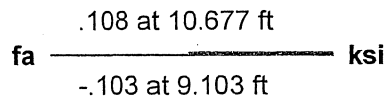
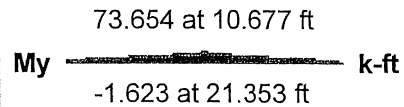
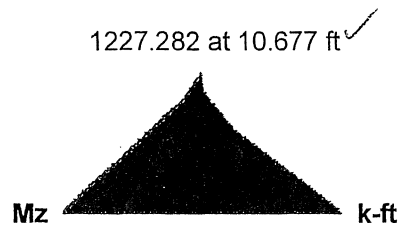
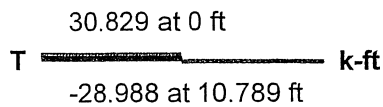
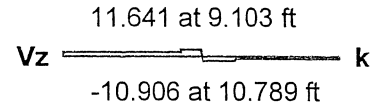
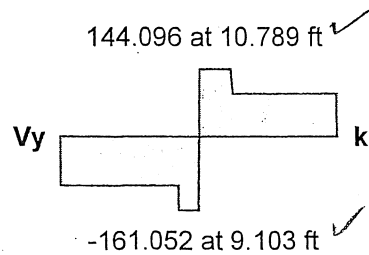
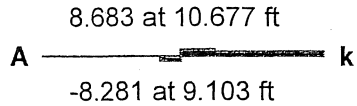
LC 1: Lanes Seperate

Code Check: **0.000 (bending)**

Report Based On 191 Sections

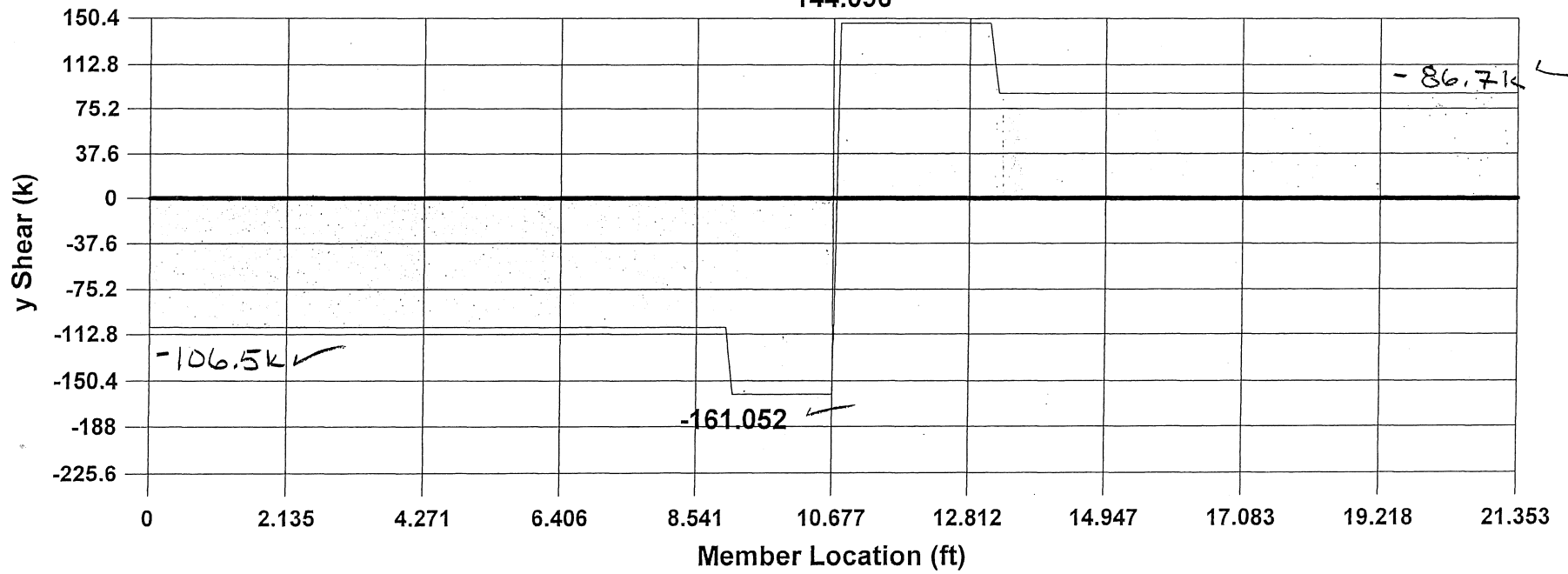


✓CSM
5/17/10



Member M1 , LC 1: Lanes Seperate

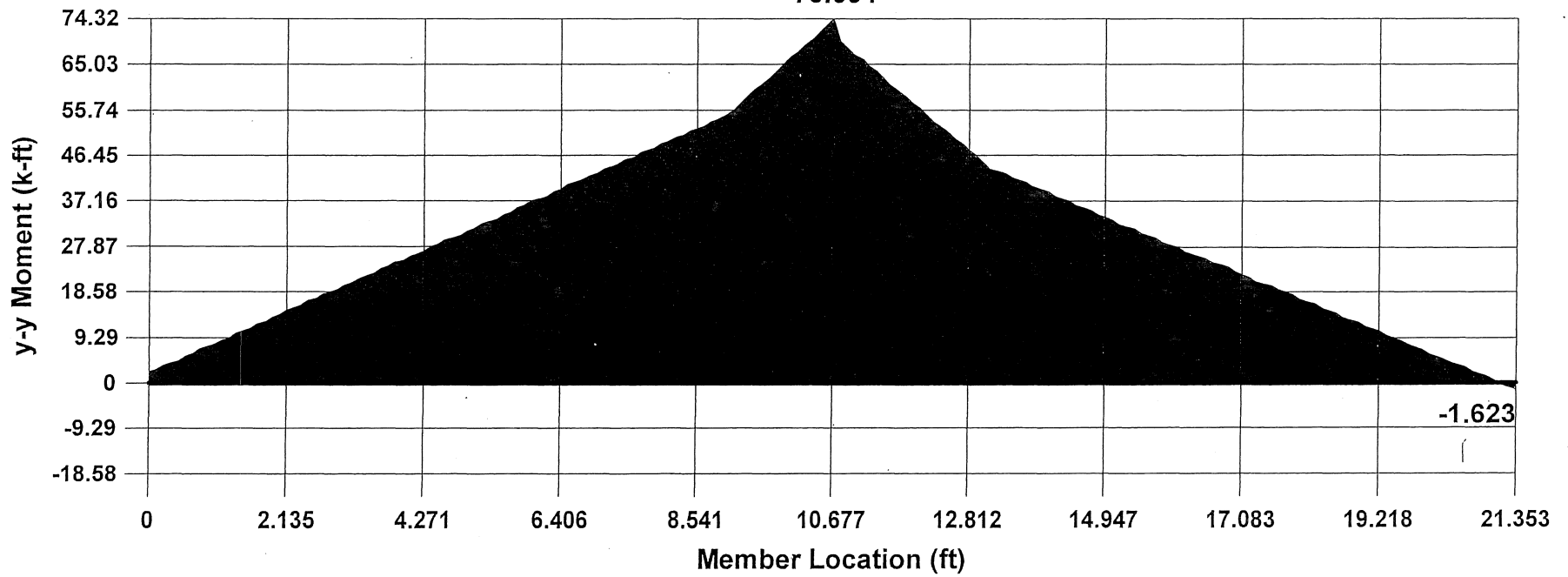
144.096



✓ CS 111
5/17/10

L-2

Member M1 , LC 1: Lanes Seperate
73.654



7.193' → 4_i → 43.7 kip·ft ✓

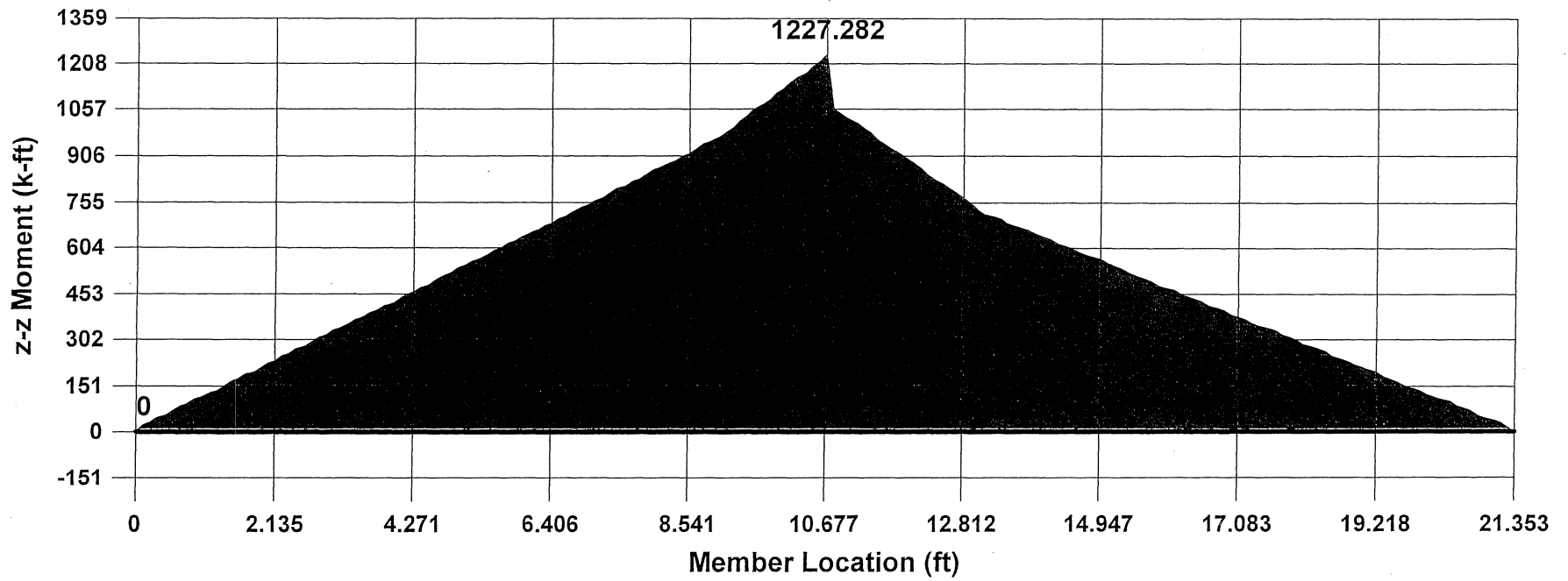
14.947' → 4_c → 33.5 kip·ft ←

7.516' (use 7.53') → 4_h → 45.6 kip·ft

1/25/10
JCSM

3-7

Member M1 , LC 1: Lanes Seperate



7.193' → 4i → 765.6 kip.ft ←
 14.947' → 4c → 555.6 kip.ft ←

LC1
 5/17/10

4-7

Beam: **M1**

Shape: **BR3A-4a-RevisedJ**

Material: **A36 Steel**

Length: **21.353 ft**

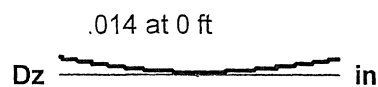
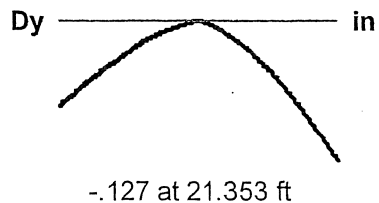
I Joint: **N2**

J Joint: **N6**

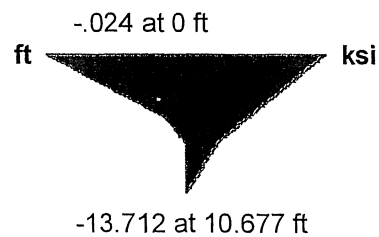
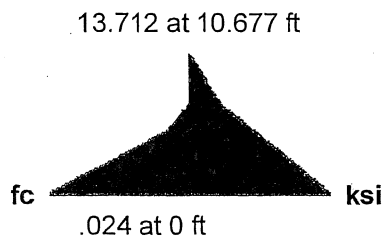
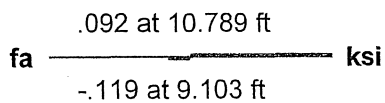
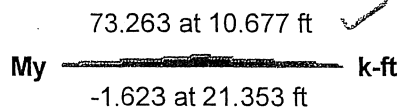
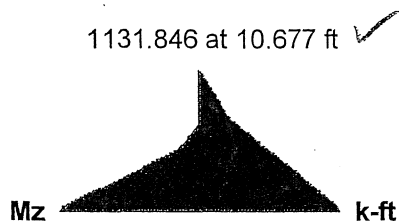
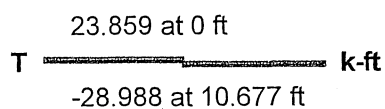
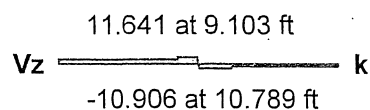
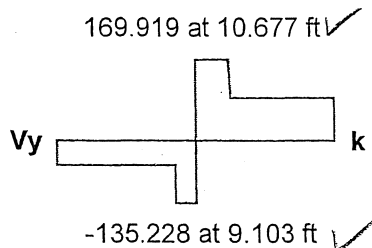
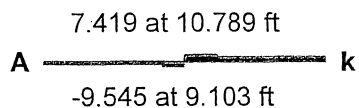
LC 2: Lanes Together R

Code Check: **0.000 (bending)**

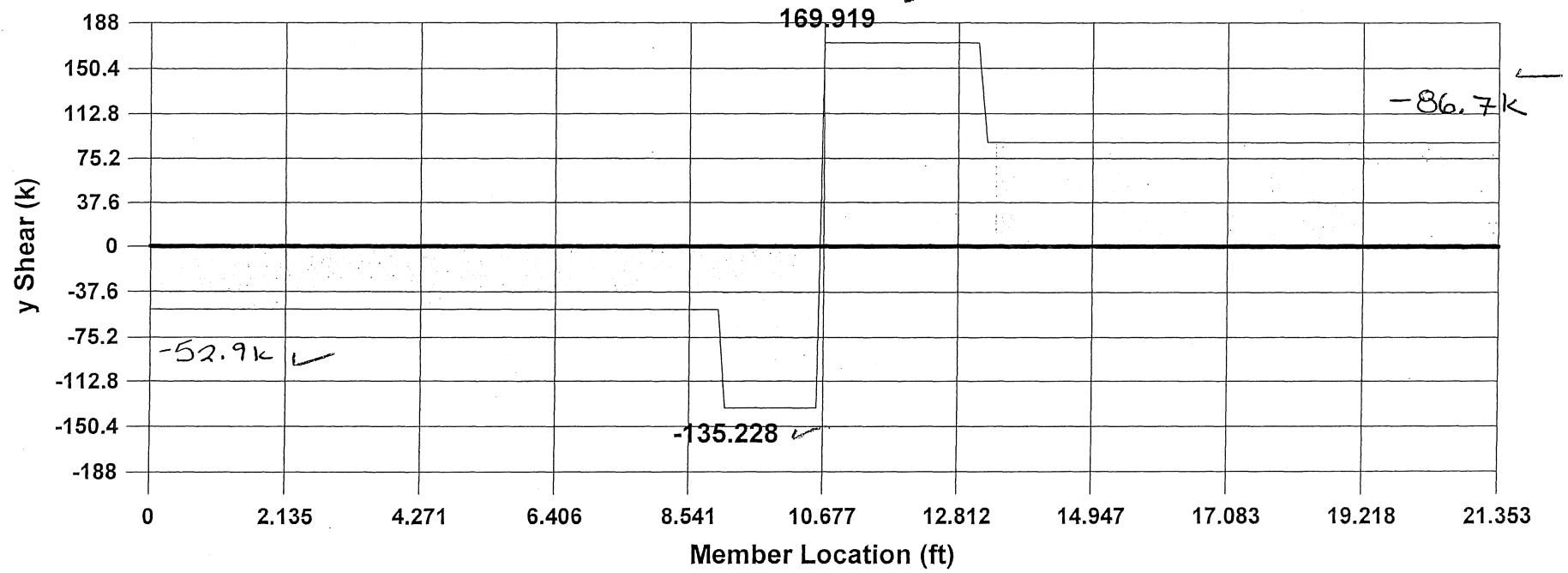
Report Based On 191 Sections



✓com
5/17/10



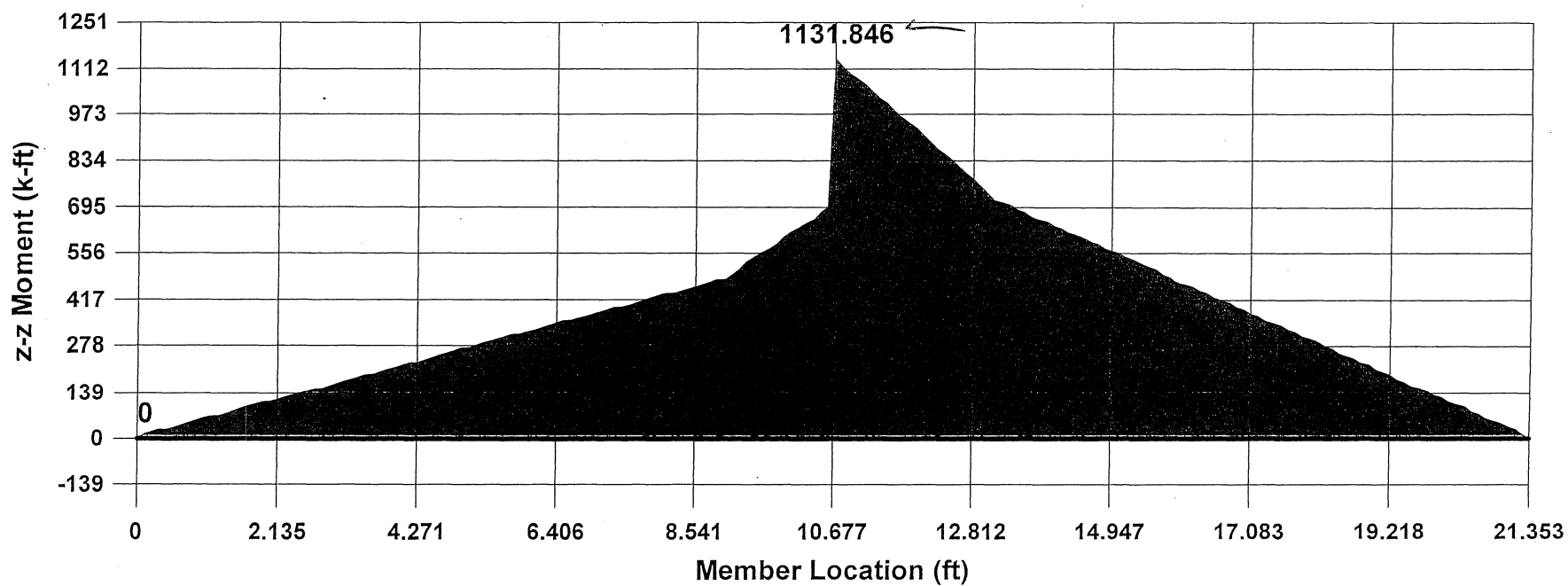
Member M1 , LC 2: Lanes Together R



4/15/10
517/10
JCS

9-7

Member M1 , LC 2: Lanes Together R



14.947' → 4C → 555.6 kip-ft. ✓

✓
5/17/10

1-1

Beam: **M1**

Shape: **BR3A-4a-RevisedJ**

Material: **A36 Steel**

Length: **21.353 ft**

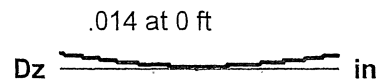
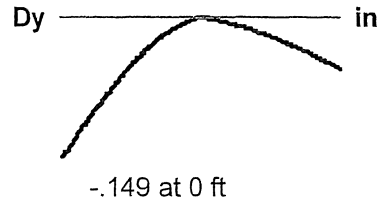
I Joint: **N2**

J Joint: **N6**

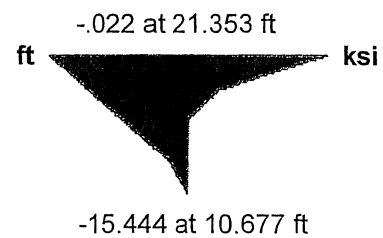
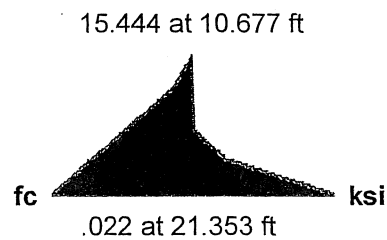
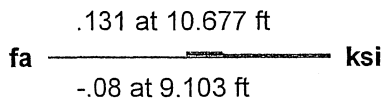
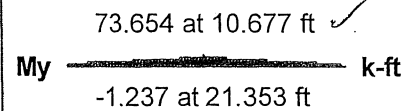
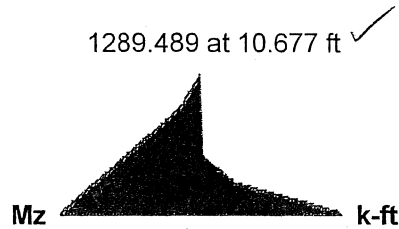
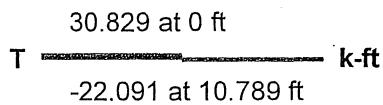
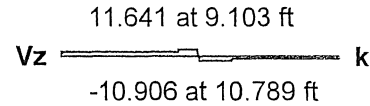
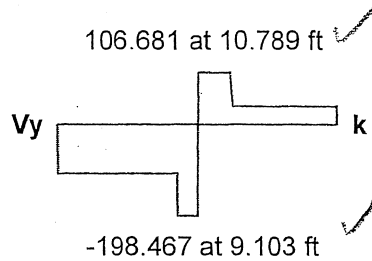
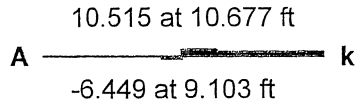
LC 3: Lanes Together L

Code Check: **0.000 (bending)**

Report Based On 191 Sections

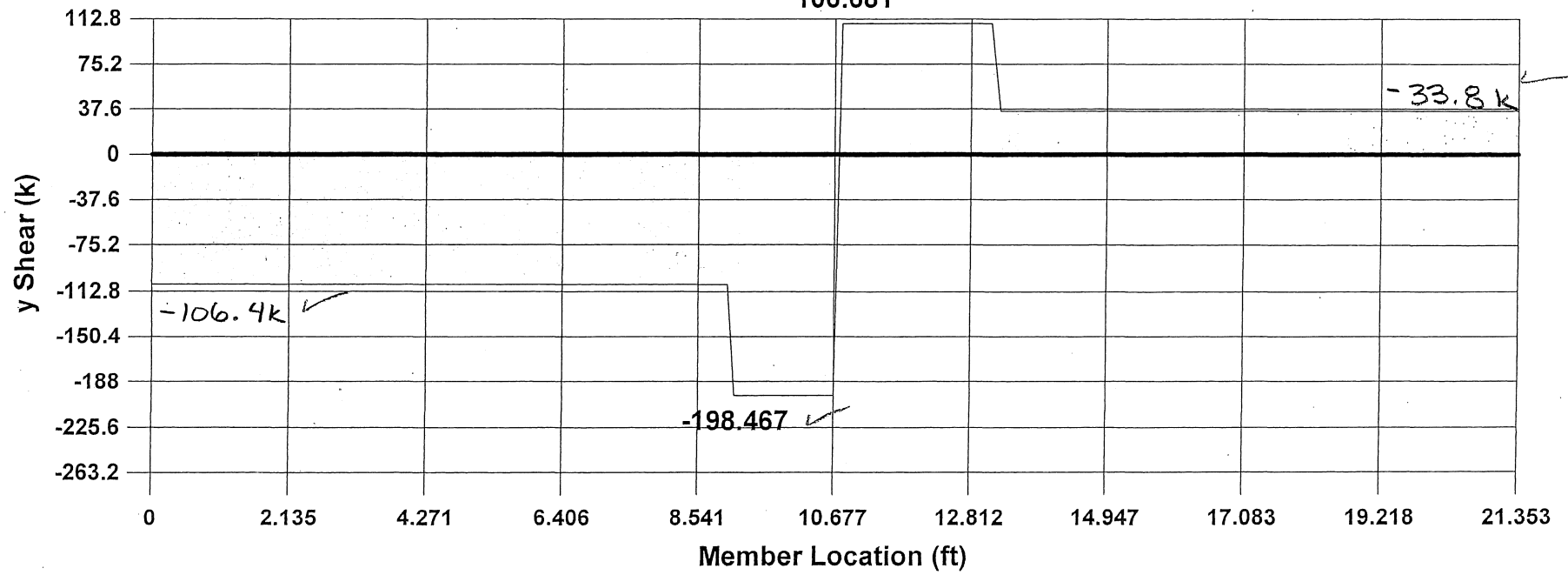


✓CJL9
5/17/10



Member M1 , LC 3: Lanes Together L

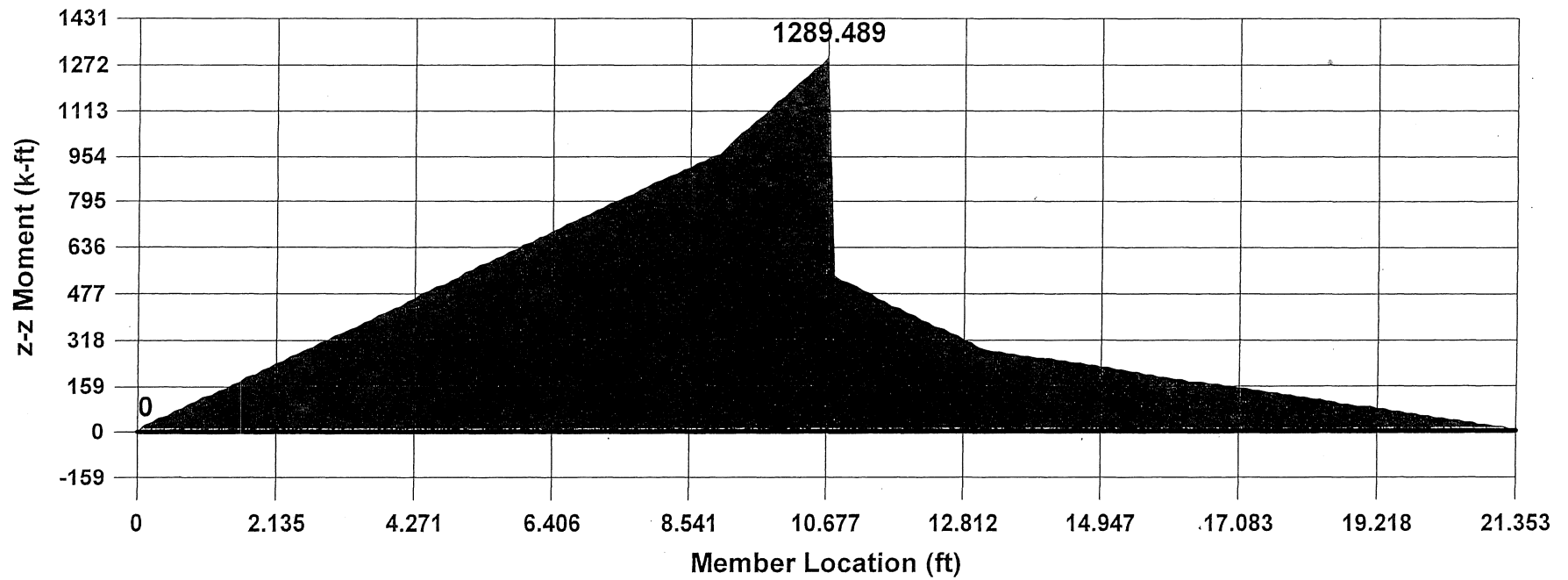
106.681 ✓



✓
LC3
5/17/10

L-9

Member M1 , LC 3: Lanes Together L



$7.193' \rightarrow 4i \rightarrow 765.6 \text{ kip}\cdot\text{ft.}$ ✓
 $7.53' \rightarrow 4h \rightarrow 801.5 \text{ kip}\cdot\text{ft.}$ —

10.677
 1289.489

Beam: **M1**

Shape: **BR3A-4a-RevisedJ**

Material: **A36 Steel**

Length: **21.353 ft**

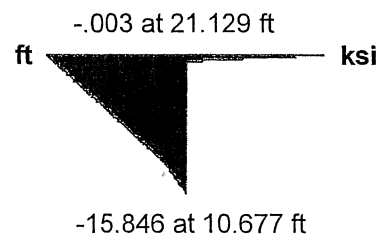
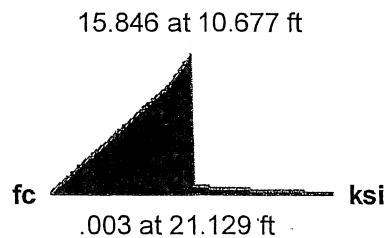
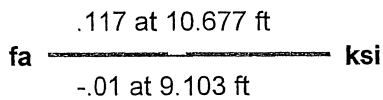
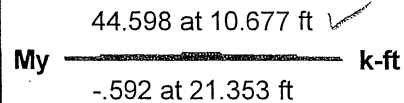
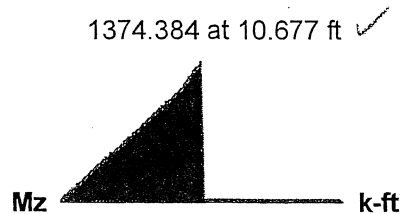
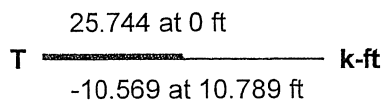
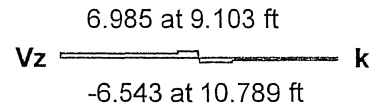
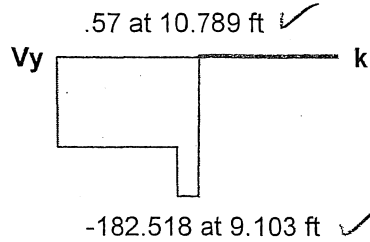
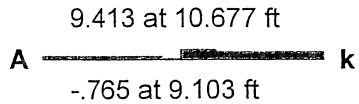
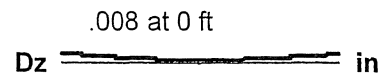
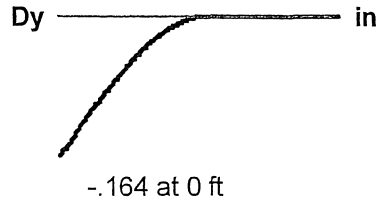
I Joint: **N2**

J Joint: **N6**

LC 4: One Lane Left

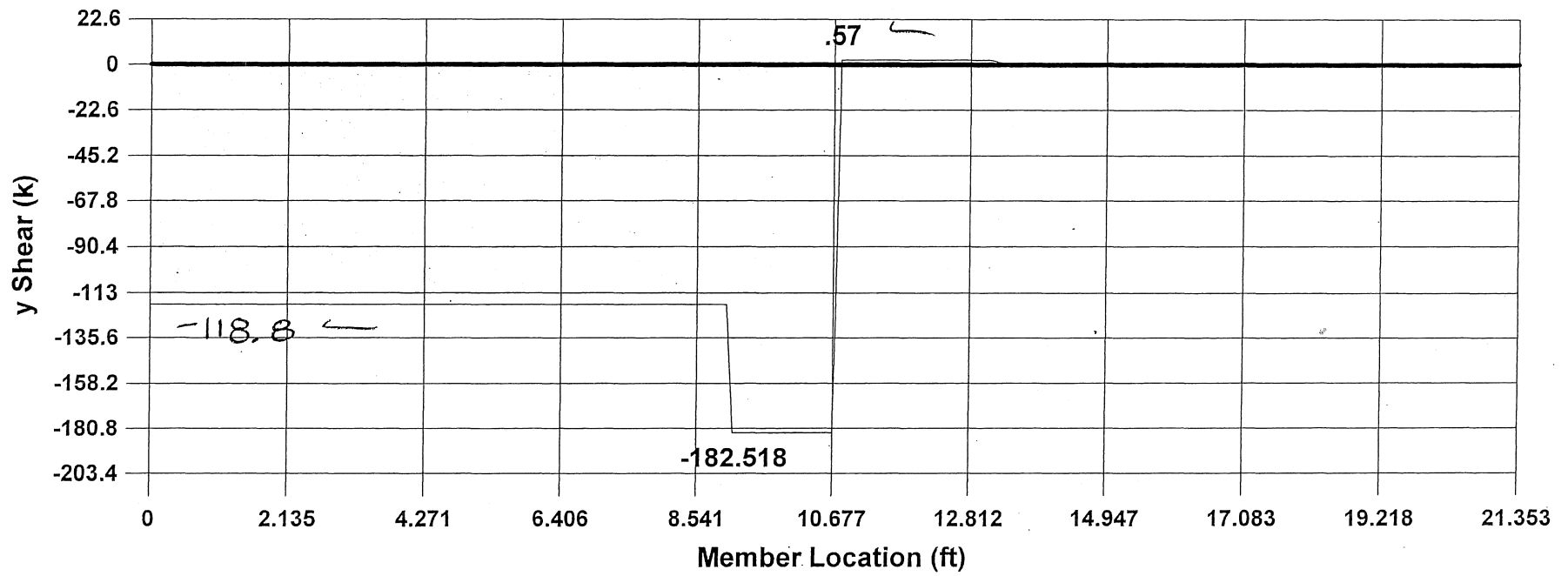
Code Check: **0.000 (bending)**

Report Based On 191 Sections



✓e34
5/17/10

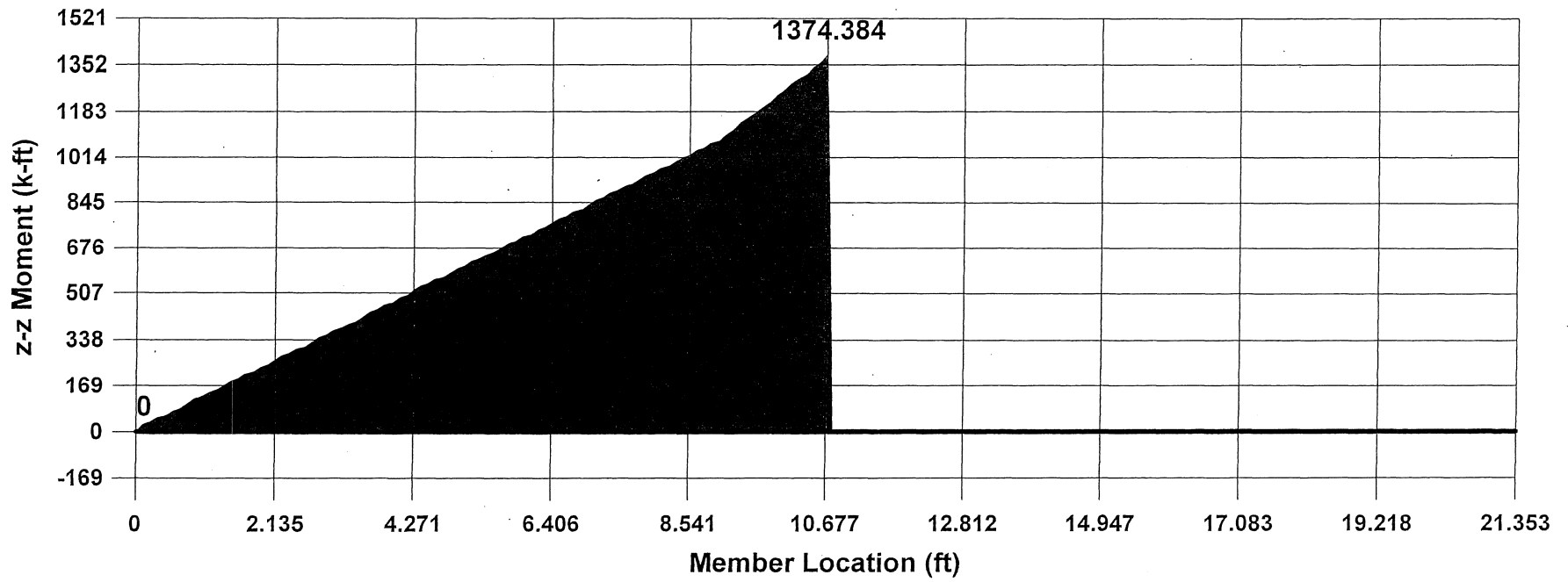
Member M1 , LC 4: One Lane Left



LC5M
5/17/10

61-7

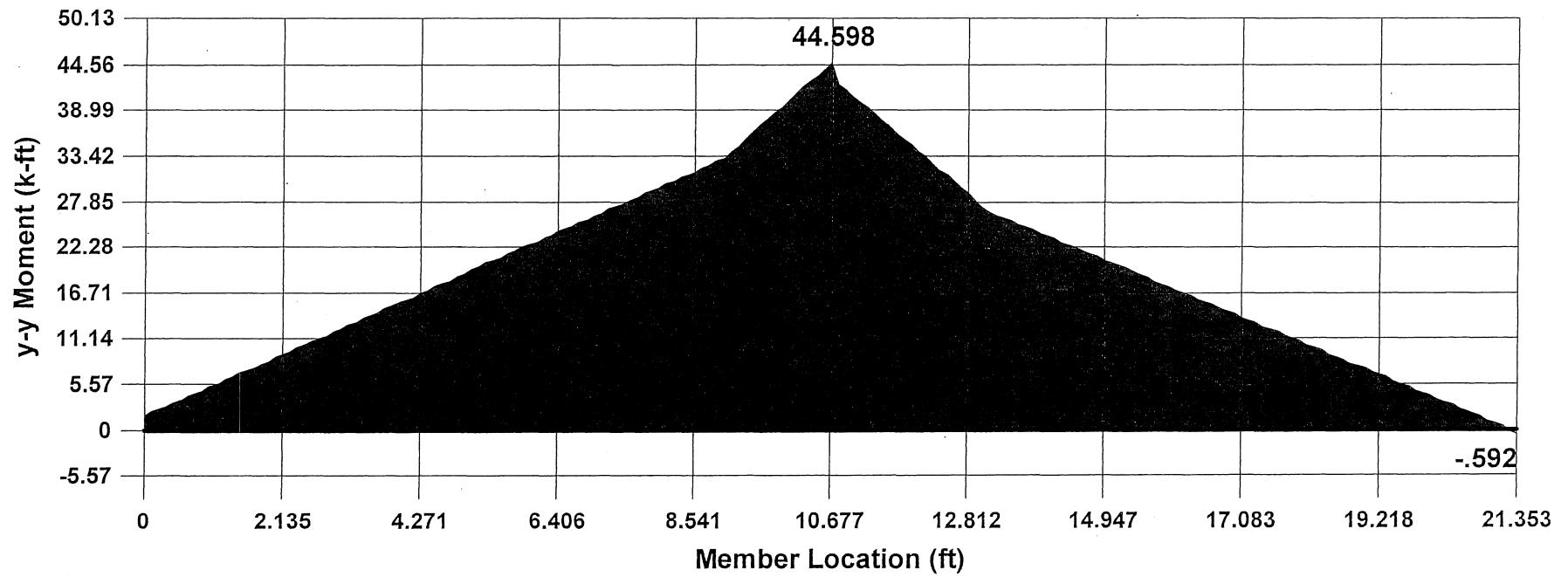
Member M1 , LC 4: One Lane Left



$7.53' \rightarrow 4h \rightarrow 894.6 \text{ kip}\cdot\text{ft} \leftarrow$
 $7.19' \rightarrow 4i \rightarrow 854.5 \text{ kip}\cdot\text{ft} \leftarrow$

105M
 51710

Member M1 , LC 4: One Lane Left



$7.53' \rightarrow 4h \rightarrow 27.8 \text{ kip}\cdot\text{ft} \leftarrow$
 $7.19' \rightarrow 4i \rightarrow 26.6 \text{ kip}\cdot\text{ft} \leftarrow$

VCSM
 5/17/10

71-7

Beam: **M1**

Shape: **BR3A-4a-RevisedJ**

Material: **A36 Steel**

Length: **21.353 ft**

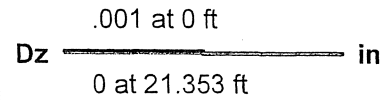
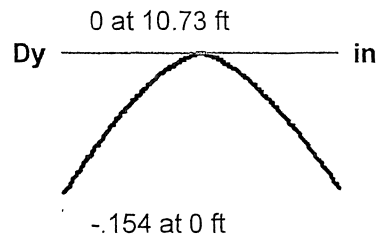
I Joint: **N2**

J Joint: **N6**

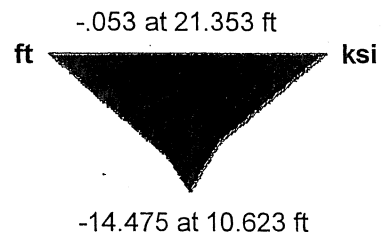
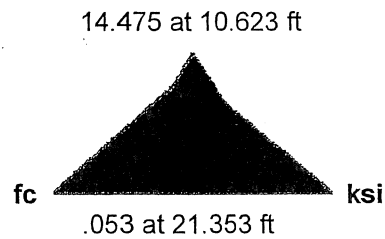
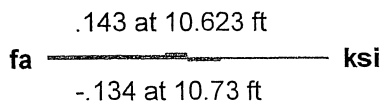
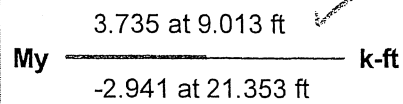
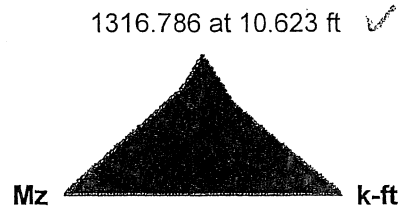
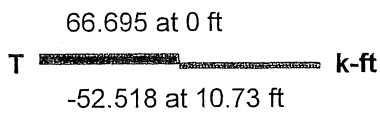
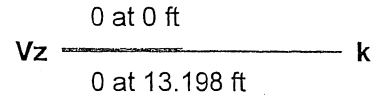
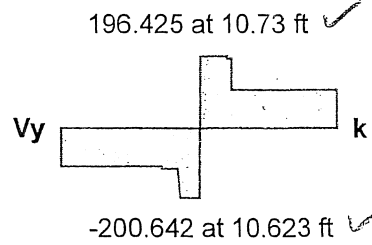
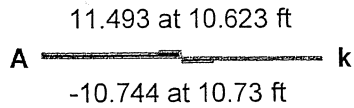
LC 5: All Dead Loads

Code Check: **0.000 (bending)**

Report Based On 200 Sections



✓CSM
initial
check
5/17/10
recheck
6/13/10



Beam: **M1**

Shape: **BR3A-4a-RevisedJ**

Material: **A36 Steel**

Length: **21.353 ft**

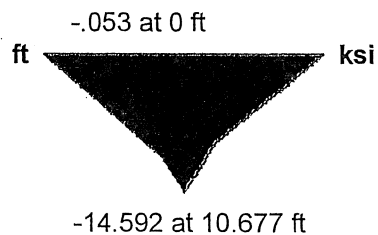
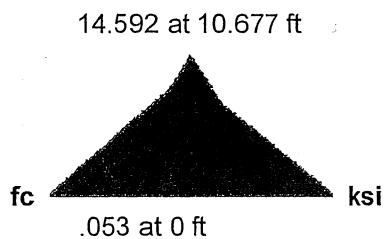
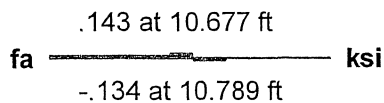
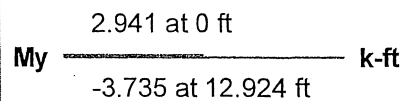
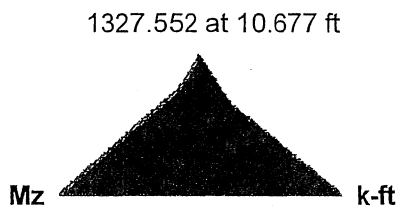
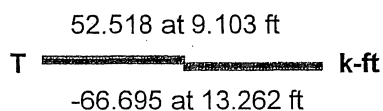
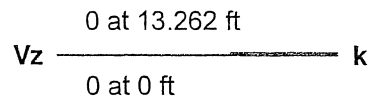
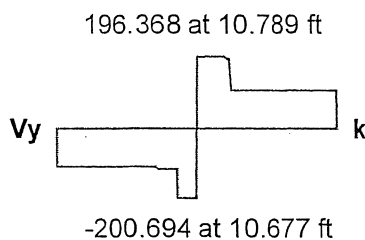
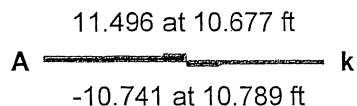
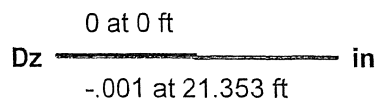
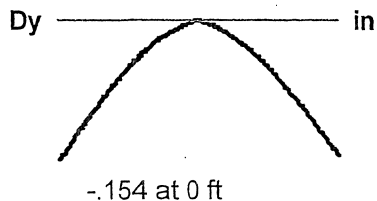
I Joint: **N2**

J Joint: **N6**

LC 5: All Dead Loads

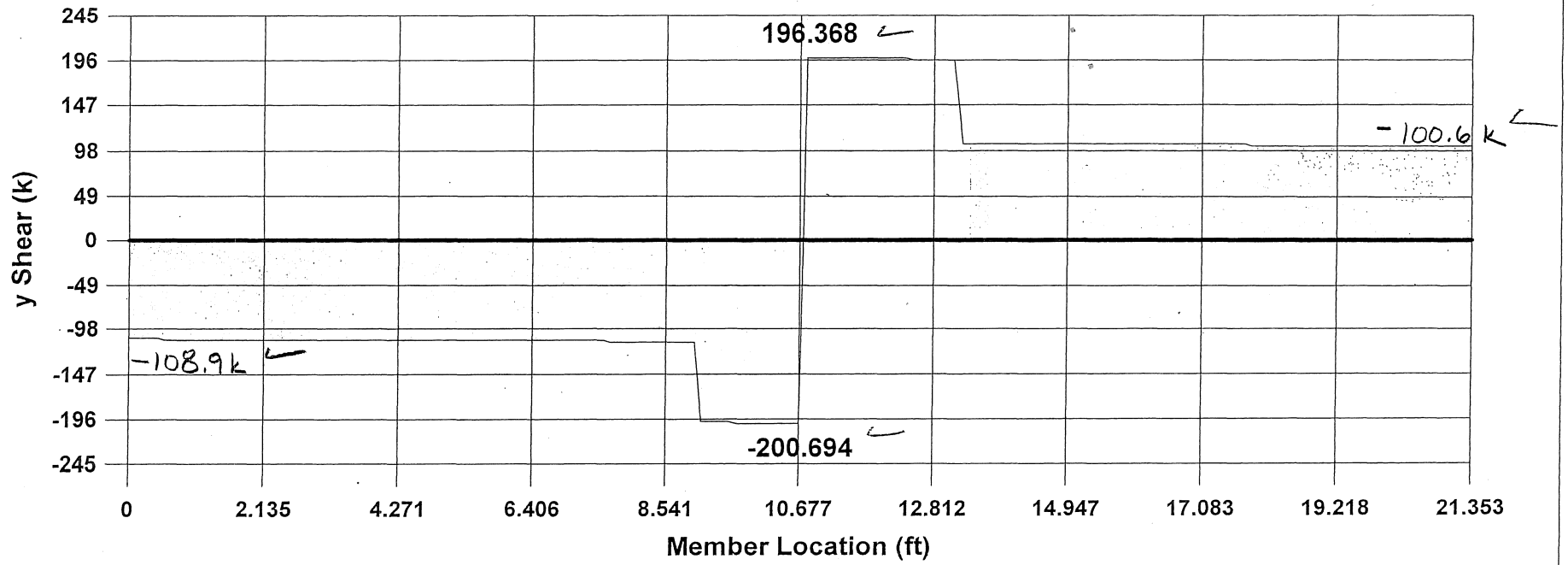
Code Check: **0.000 (bending)**

Report Based On 191 Sections



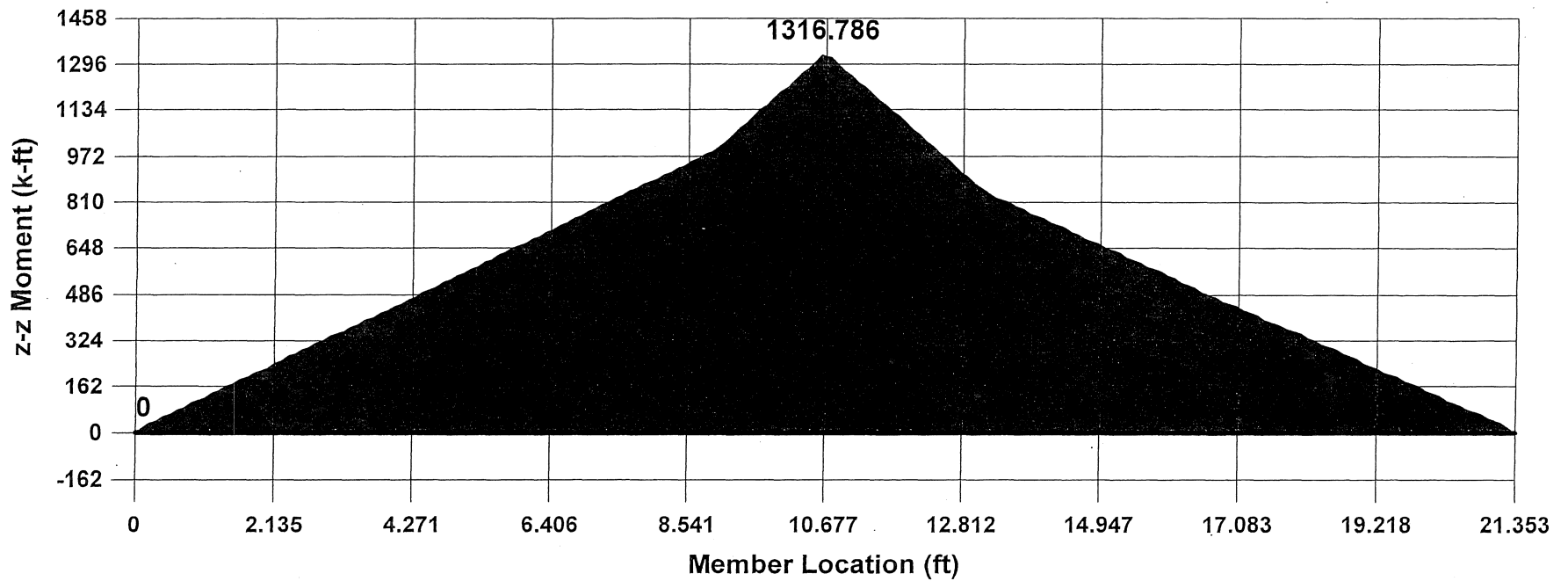
5 6/11/10

Member M1 , LC 5: All Dead Loads



LC5M
5/18/10

Member M1 , LC 5: All Dead Loads



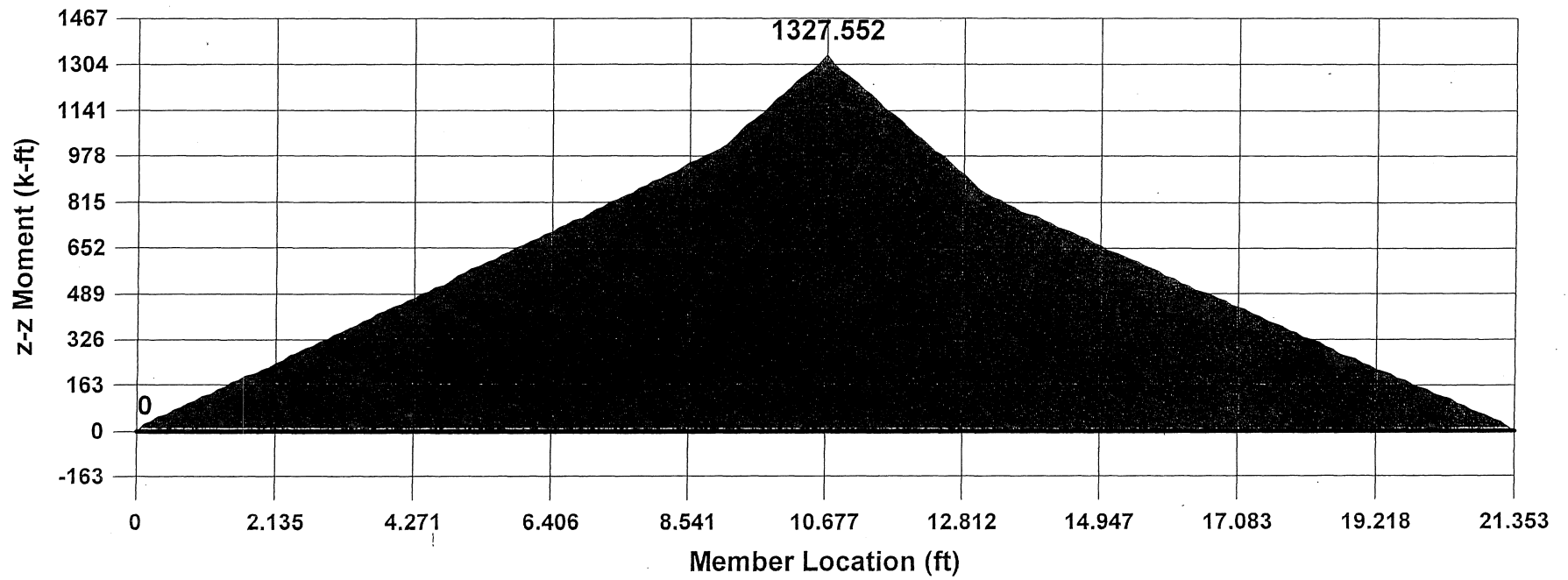
(new values will not be used)

7.193' → 4i → 790.94 kip.ft ✓
 14.947' → 4c → 654.08 kip.ft. ✓
 7.53' → 4h → 826.78 kip.ft ✓

✓
 6/24/10
 6/24/10

81-7

Member M1 , LC 5: All Dead Loads



7.193' → 4i → 791.3 kip·ft ✓ on
 14.947' → 4c → 650.8 kip·ft ✓ on
 7.53' → 4h → 828.9 kip·ft ✓ on

1/5/19
 6/12/19

61-7

Beam: **M1**

Shape: **BR3A-4a-RevisedJ**

Material: **A36 Steel**

Length: **21.353 ft**

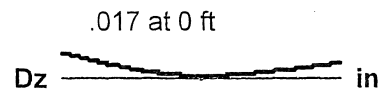
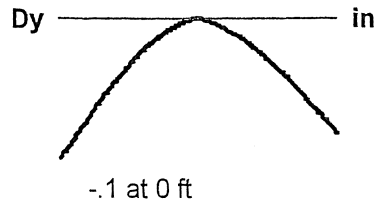
I Joint: **N2**

J Joint: **N6**

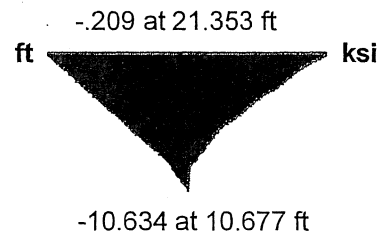
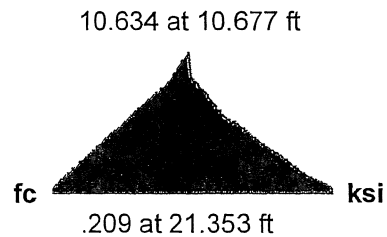
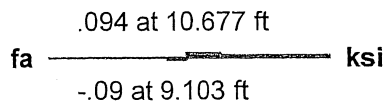
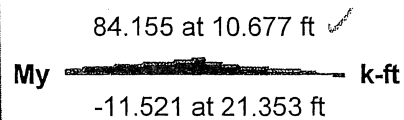
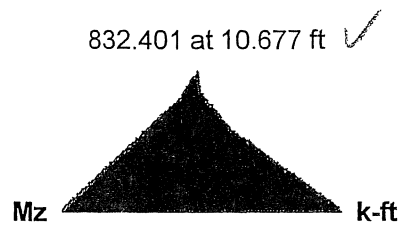
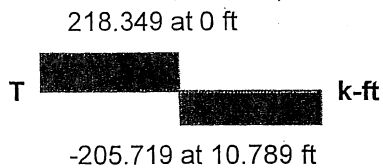
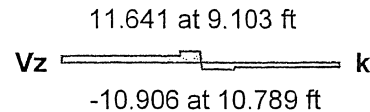
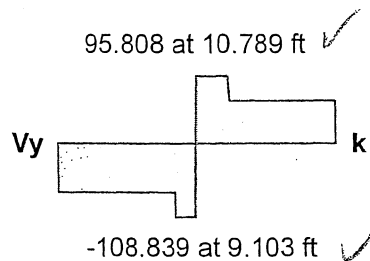
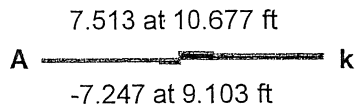
LC 6: Max Torque

Code Check: **0.000 (bending)**

Report Based On 191 Sections

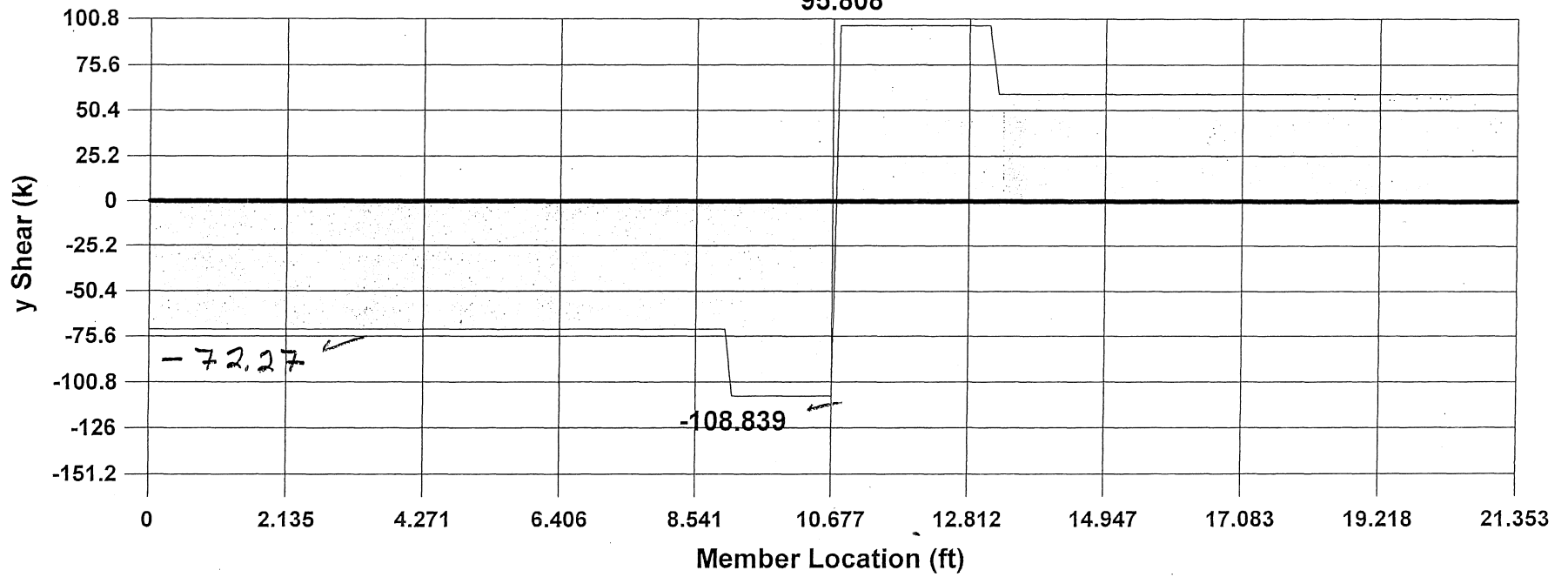


✓CSM
5/17/10



Member M1 , LC 6: Max Torque

95.808



105m
51710

12-7

✓CSM
5/18/12

Beam: **M1**

Shape: **BR3A-4a-RevisedJ**

Material: **A36 Steel**

Length: **21.353 ft**

I Joint: **N2**

J Joint: **N6**

LC 7: 100kipft Torque

Code Check: **0.000 (bending)**

Report Based On 191 Sections

Dy _____ in

Dz _____ in

-.002 at 21.353 ft

A _____ k

Vy _____ k

Vz _____ k

0 at 13.262 ft

0 at 0 ft

T _____ k-ft

Mz _____ k-ft

My _____ k-ft

.003 at 9.103 ft

-99.84 at 13.262 ft ✓

0 at 0 ft

-5.592 at 12.7 ft

fa _____ ksi

fc _____ ksi

ft _____ ksi

.101 at 12.7 ft

-.101 at 12.7 ft

Beam: **M1**

Shape: **BR3A-4a-RevisedJ**

Material: **A36 Steel**

Length: **21.353 ft**

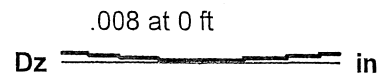
I Joint: **N2**

J Joint: **N6**

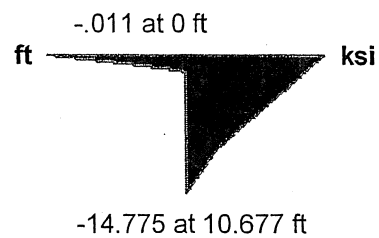
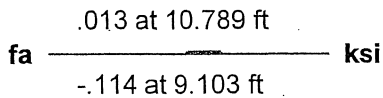
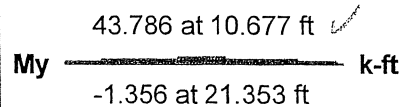
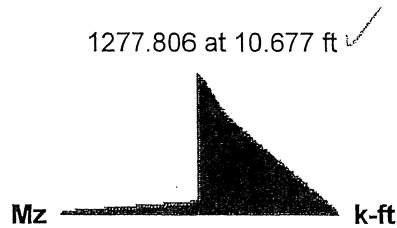
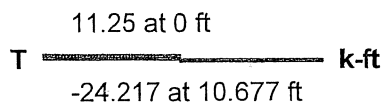
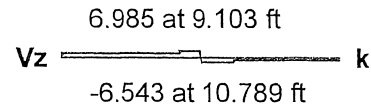
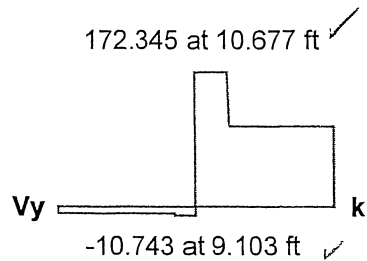
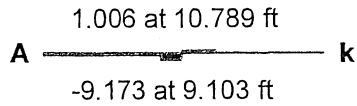
LC 8: One Lane Right

Code Check: **0.000 (bending)**

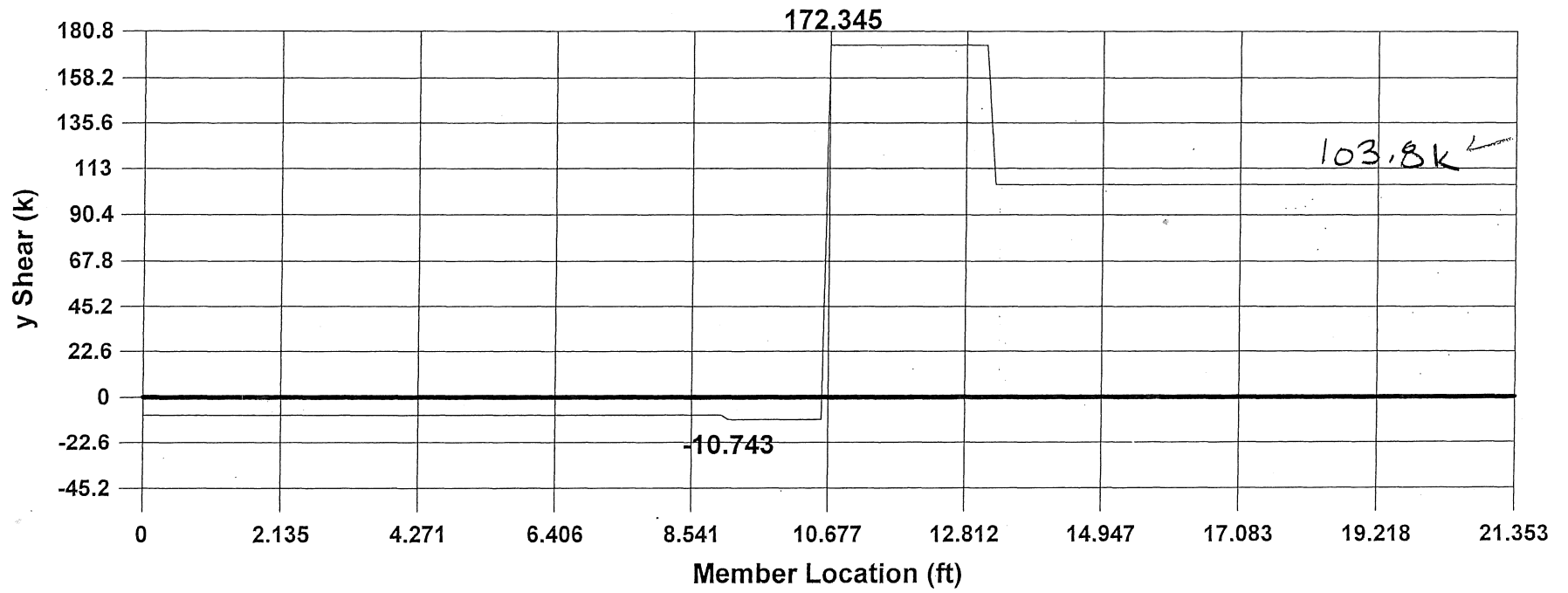
Report Based On 191 Sections



✓c5w1
5/17/10



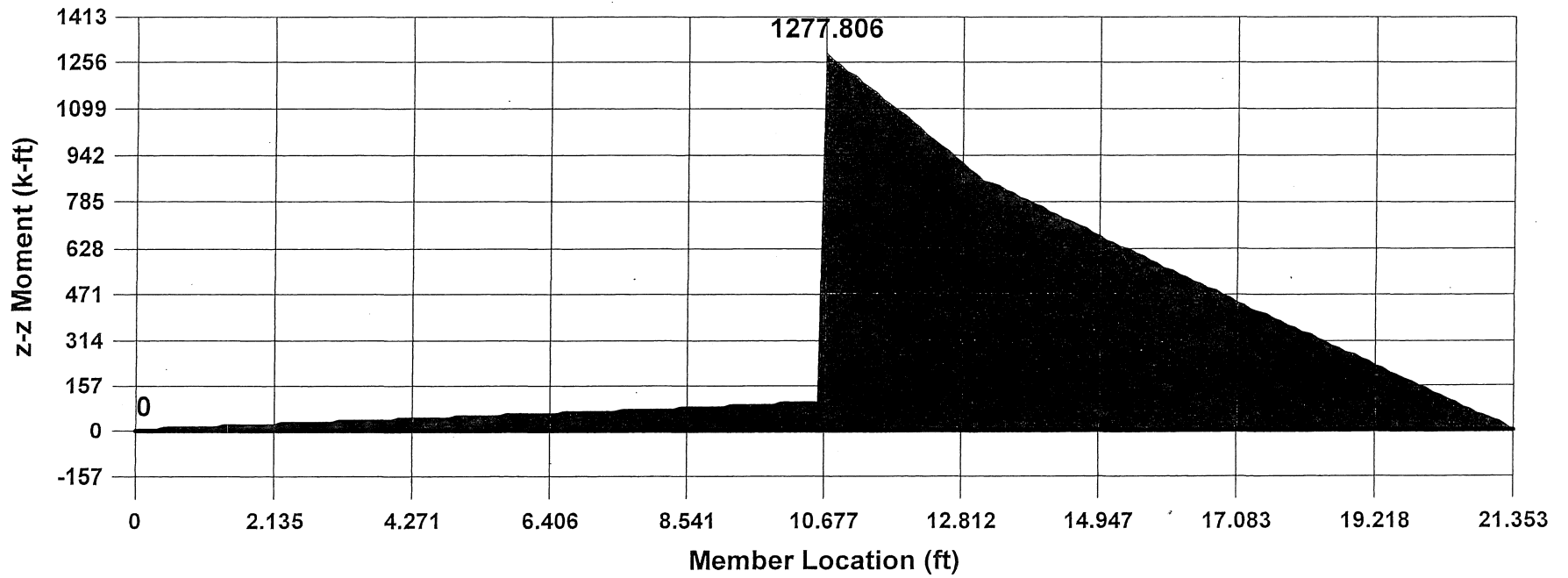
Member M1 , LC 8: One Lane Right



LC8
Shear

11-11

Member M1 , LC 8: One Lane Right

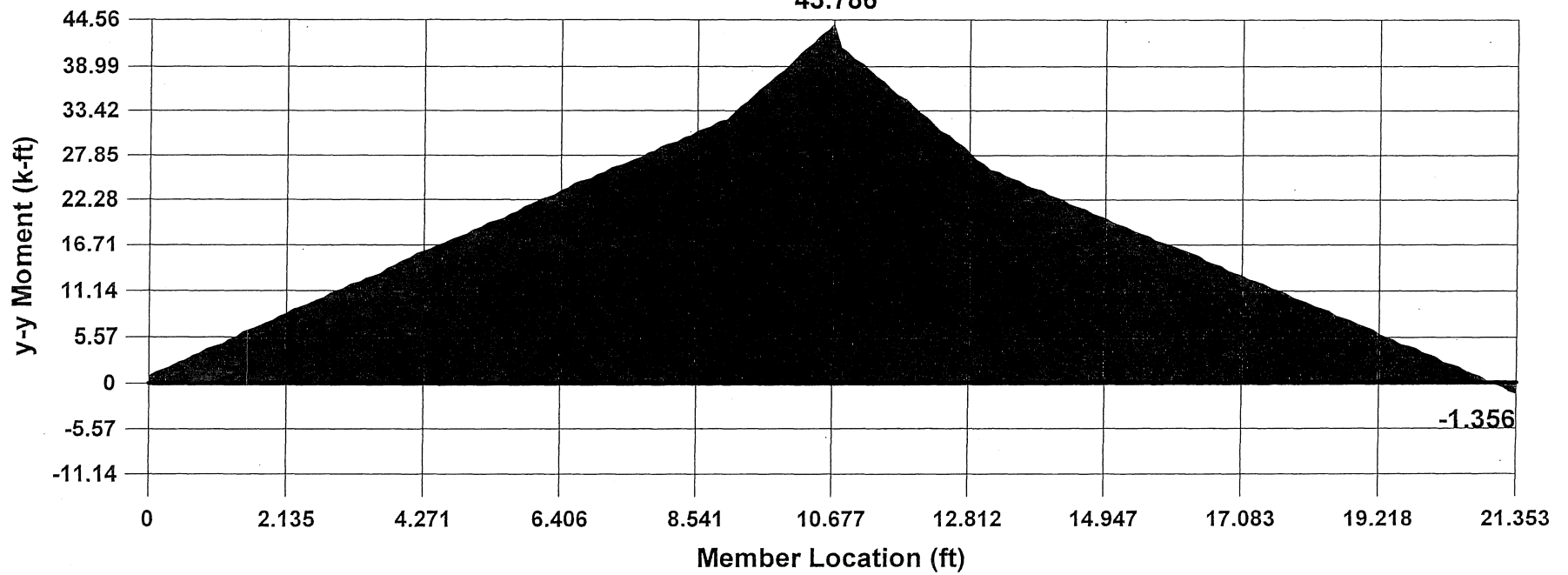


14.947' → 4c → 664.94 kip-ft. ←

LC8M
5/17/12

Member M1 , LC 8: One Lane Right

43.786



14.947 → 4c → 19.71 k.p.ft

✓
5/17/10

L-26

Beam: **M1**

Shape: **BR3A-4a-RevisedJ**

Material: **A36 Steel**

Length: **21.353 ft**

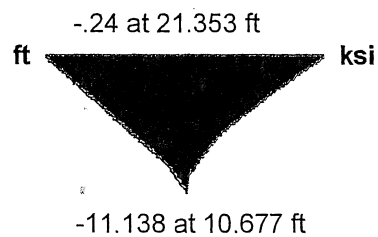
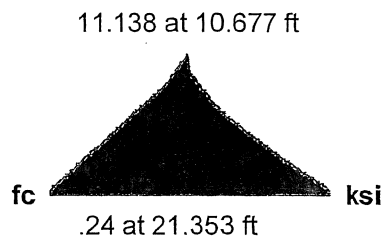
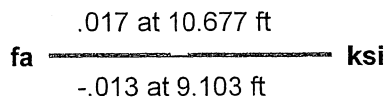
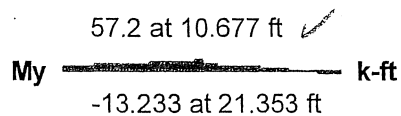
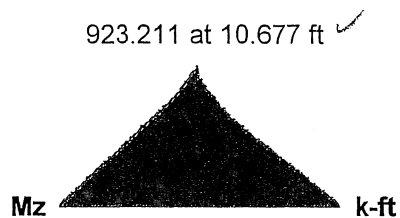
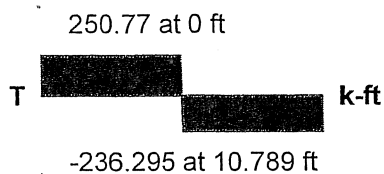
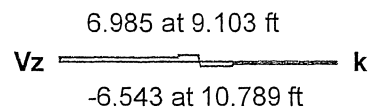
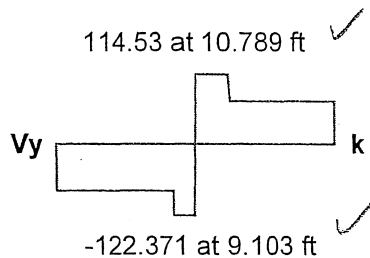
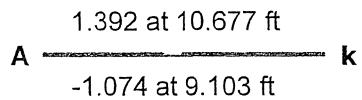
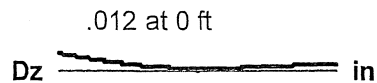
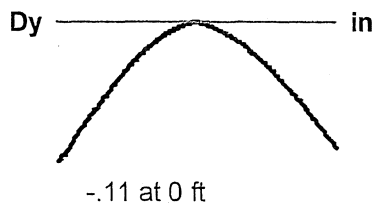
I Joint: **N2**

J Joint: **N6**

LC 9: Max One Lane Torque

Code Check: **0.000 (bending)**

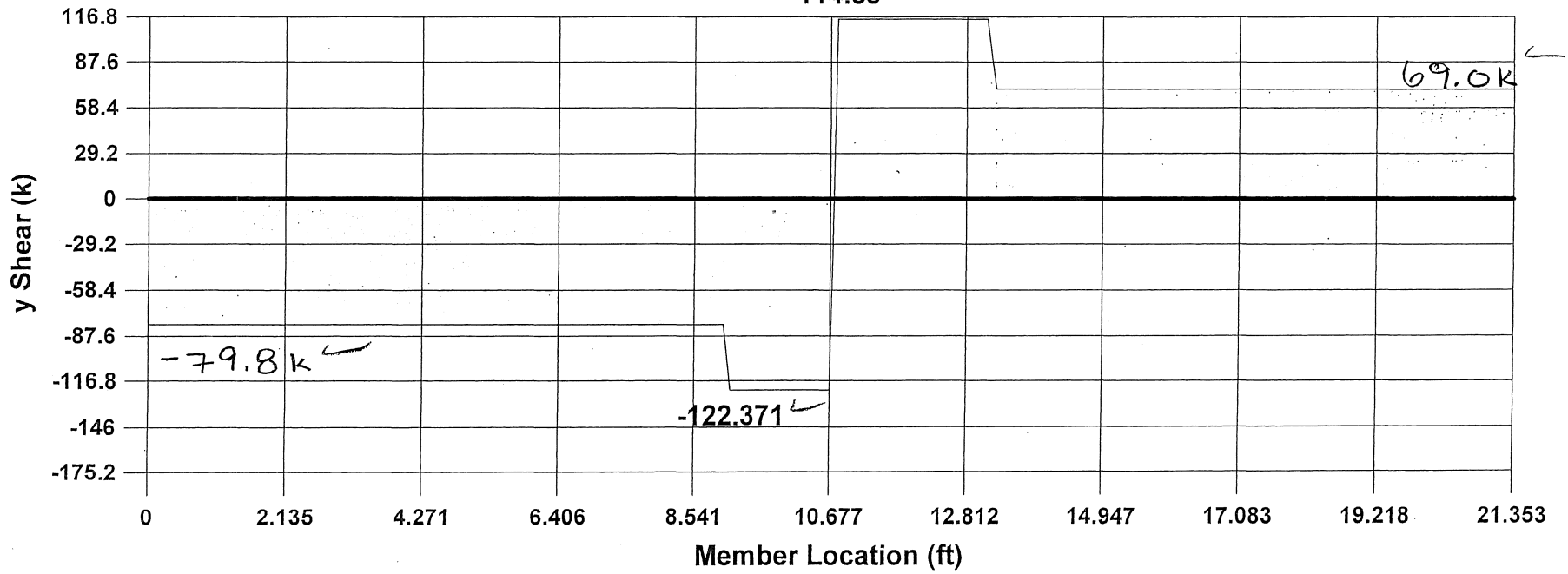
Report Based On 191 Sections



✓esm
5/17/10

Member M1 , LC 9: Max One Lane Torque

114.53 ✓



LC9M
5/17/10



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Duluth, Minnesota 55802
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250 3rd Avenue North, Suite 450
Minneapolis, Minnesota 55401
612 338-2029
Fax 612 338-2088

PROJECT MnDOT SS-69801J - P4-3A - Rise 3D Results -1
PROJECT # 090147 DATE 4/19/10 BY jaf SHEET NO. _____ OF _____

Rise 3D Load Combinations:

LC 10- LC 24: Posting / Permit with max legal truck. Loadings for maximum Reaction.

LC 25- LC 39: Posting / Permit truck with max legal truck (SUZ). Loads for maximum torsion.

LC 40- LC 54: Just Posting or Permit Truck. Loads for maximum Reaction.

LC 55- LC 69: Just Posting or Permit Truck. Loads for maximum Torsion.

See the Posting and Permit truck calculation area for these Rise 3D Results.



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Fax 612 338-2088

PROJECT MnDOT SS-69801J-3A-P4 - Flexural Capacity
PROJECT # 090147 DATE 6/11/10 BY jdf SHEET NO. _____ OF _____

New 6/11/10

The method used to determine the flexural capacity which follows may be conservative for sections with slender flanges. Flexural strength does not control design and therefore this conservativeness will not affect answers.

Refer to AISC LRFD steel code for a possible alternative method if one is required in future work.

648613-3A P4
STRENGTH

Project: MnDOT Special Structures - 69801J - Bridge 3A Pier 4
 Date: 21-May-10
 RisaSection Name: BR3A-P4-c

Project Number: 90147

Eng: JDF

Checked By:

com initial 5/14/10
 rectack 6/25/10

Spreadsheet has been created for use with Box Steel Beam Caps Only.

For sections with compact, non-compact, or slender flanges.

For sections with compact or non-compact webs.

Yield Strengths:	Fyc:	36 ksi	Fyt:	36 ksi	Fyw:	36 ksi
Modulus of Elasticity:	E:	29000 ksi				
Compression Flange:	bfc:	36 in	trc:	0.75 in		
Tension Flange:	btc:	36 in	trt:	0.75 in		
Webs:	D:	40.125 in	tw:	0.375 in		
Clear Space between webs:		30 in				
Unbraced Length:	Lb:	98.05 in				
Neutral Axis:	Y-bar (Comp)	20.813 in	Y bar (Ten)	20.813 in	X-bar	18 in
Moment of Intertia:	Ixx	26500 in^4	Iyy	12770 in^4		
Section Modulus:	Sx (Comp)	1277.86 in^3	Sx (Ten)	1277.86 in^3	Sy	709.65 in^3
Radius:	rx	17.784 in	ry	12.325 in		
Plastic Modulus:	Zx	1405.5 in^3	Zy	943.05 in^3		
Torsional Constant:	J	11.455 in^4				

Based on AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition, 2007, With 2008 & 2009 Interim Revisions

Article 6.10 - I-Section Flexural Members

Article 6.10.6 - Strength Limit State

Article 6.10.6.2 - Flexure

Article 6.10.6.2.3 - Composite Sections in Negative Flexure and Noncomposite Sections

If the following conditions are met, proportion the section according to the provisions for compact or noncompact web sections specified in Appendix A. Otherwise, the section shall be proportioned according to provisions specified in Article 6.10.8.

Depth of Web in Comp:	Dc:	20.063 in
Moment of Inertia Comp Flange:	Iyc:	2916.0 in^4
Moment of Inertia Tens Flange:	Iyt:	2916.0 in^4

Yield Strength Limit:	Max Fy:	36 ksi	Limit Fy:	70 ksi	OK - Keep Going
Web Slenderness Limit (slender):	2*Dc/tw:	107.0027	5.7*(E/Fyc)^.5:	161.8 ksi	OK - Keep Going
Flange Ratio:	Iyc/Iyt:	1	Limit:	0.3	OK - Keep Going

Appendix A6: Flexural Resistance of Straight Composite I-Sections in Negative Flexure and Straight Non-composite I-sections with Compact or Noncompact Webs

Article A6.1 - General - Same as Article 6.10.6.2.3 above.

Article A6.1.1 - Sections with Discretely Braced Compression Flanges

At the limit state the following requirement shall be satisfied:

$$M_u + (1/3) * f_l * S_{xc} \leq \phi(f) * M_{nc}$$

Bending Moment - Major Axis:	Mu:	Varies, see Risa 3D
Flange Lateral Bending Stress:	fi:	See Article 6.10.1.6

Flange lateral bending stress, f_l , may be determined directly from first-order elastic analysis in discretely braced compression flanges for which: $b \leq 1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{.5}$

Limiting Unbraced Length:	Lp:	See Article 6.10.8.2.3
	Lp:	$1.0 * r_t * (E / F_y)^{.5}$
Effective Radius of Gyration:	rt:	$b_{fc} / (12 * (1 + (1/3) * (D_c * t_w / (b_{fc} * t_{fc}))))^{.5}$
	rt:	9.9 in
	Lp:	282.1 in

Moment Gradient Modifier:	Cb:	See Article 6.10.8.2.3 or Article A6.3.3, as applicable
	Cb:	1 Since $M_{mid} / M_2 > 1$ at most situations. May be conservative at some locations.

Web Load-shedding Factor:	Rb:	See Article 6.10.1.10.2 1.0 if $2 * D_c / t_w \leq \lambda_{md} (r_w)$
Web Slenderness Limit (noncompact):	$\lambda_{md} (r_w)$:	$5.7 * (E / F_y)^{.5}$ 161.8
	$2 * D_c / t_w$:	107.0027
	Rb:	1

Major Axis Bending to Yield Moment:	M_u / M_{yc} :	1 Assume 1.0. Conservative.
-------------------------------------	------------------	-----------------------------

Unbraced Limit for f_l :	Lb:	98.05 in	$1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{.5}$	338.6 in	OK - Keep Going, First-order elastic analysis
----------------------------	-----	----------	---	----------	---

Flange Lateral Bending Stress:	fi:	M_{uy} / S_y First-order elastic analysis
Factored Weak Axis Bending Moment:	Muy:	See Risa

Resistance Factor for Flexure:	$\phi(f)$:	1 As specified in Article 6.5.4.2
--------------------------------	-------------	-----------------------------------

Nominal Flexural Resistance: Mnc: See Article A6.3

Nominal Flexural Resistance based on compression flange, M_{nc} , shall be taken as the smaller of the local buckling resistance determined as specified in Article A6.3.2, and the lateral torsional buckling resistance determined as specified in Article A6.3.3.

Article A6.3.2 - Local Buckling Resistance:

Determine if the compression flange is compact:

M-1

Limiting Slenderness Ratio for Compact Flange:

Use two ratios, one for the flange between the webs, and the other for the flange overhang. See AISC Table B4.1.

Case 12: Uniform compression in flanges of rectangular box and hollow structural sections of uniform thickness subject to bending or compression.

lamda(f)	b/t:	40.00 <i>Clear space between webs/t_f</i>
lamda(pf)	$1.12 \cdot (E/F_y)^{0.5}$:	31.79
lamda(rf)	$1.40 \cdot (E/F_y)^{0.5}$:	39.74

Case 12: Slender Flange

Case 2: Flexure in flanges of doubly and singly symmetric I-shaped built-up sections.

lamda(f)	b/t:	3.75 <i>Flange overhang measured from mid-web/t_f</i>
lamda(pf)	$0.38 \cdot (E/F_y)^{0.5}$:	10.79
lamda(rf)	$0.95 \cdot (E \cdot k_c / F_y)^{0.5}$:	20.04
k _c :	$4 / (D/t_w)^{0.5}$:	0.39 but $0.35 \leq k_c \leq 0.76$
k _c :	0.39	
F _y :	smaller of 3 items below:	
	0.7 · F _y :	25.2 ksi
	R _h · F _y · S _{xt} / S _{xc} :	36.0 ksi
	F _{yw} :	36.0 ksi
	but not less than:	
	0.5 · F _y :	18.0 ksi

F_y: 25.2 ksi

Case 2: Compact Flange

If Case 2 Flange is Noncompact or Slender, then check lamdas used.

Slender Flange *Worse condition of Case 12 and Case 2*

Compression Flange:

Nominal Flexural Resistance:

M_{nc}: $[1 - (1 - (F_y \cdot S_{xc}) / (R_p \cdot M_{yc})) \cdot (\lambda(f) - \lambda(pf)) / (\lambda(rf) - \lambda(pf))] \cdot R_p \cdot M_{yc}$

Equation A6.3.2-1 or A6.3.2-2

Web Plastification Factor - Comp:

R_{pc}: See Article A6.2.1 or A6.2.2, as applicable

Article A6.2.1 - Compact Web Sections:

Determine if the web is compact:

Compact if $2 \cdot D_{cp} / t_w \leq \lambda(pw(D_{cp}))$

Depth of Web in Comp at Plastic Mom:

D_{cp}: See Article D6.3.2

For non composite sections where: $F_{yw} \cdot A_w \geq |F_{yc} \cdot A_c - F_{yt} \cdot A_t|$, $D_{cp} = D / (2 \cdot A_w \cdot F_{yw}) [F_{yt} \cdot A_t + F_{yw} \cdot A_w - F_{yc} \cdot A_c]$, otherwise $D_{cp} = D$.

F_{yw} · A_w: 1083.375 kip | F_{yc} · A_c - F_{yt} · A_t: 0 kip

Use 2 · D · t_w for A_w due to two webs

D_{cp}: 20.1 in

Limiting Slenderness Ratio for Compact Web:

lamda(pw(D_{cp})): $((E/F_y)^{0.5}) / (0.54 \cdot (M_p / (R_h \cdot M_y)) - 0.09)^{0.5} \leq \lambda(rw) \cdot (D_{cp} / D_c)$

Plastic Moment

M_p: See Article D6.1

Article D6.1 - Plastic Moment:

M_p: See Table D6.1-2, Case I

M_p: $P_w / (2 \cdot D) \cdot [Y(\bar{b})^2 + (D - Y(\bar{b}))^2] + [P_{rt} \cdot d_{rt} + P_{rb} \cdot d_{rb} + P_t \cdot d_t + P_c \cdot d_c]$

Y($\bar{b}$): $(D/2) \cdot [(P_c - P_t - P_{rt} - P_{rb}) / P_w + 1]$

P_c: F_{yc} · b_c · t_c: 972 kip

P_t: F_{yt} · b_t · t_t: 972 kip

P_{rt}: 0 no concrete reinforcing steel

P_{rb}: 0 no concrete reinforcing steel

P_w: F_{yw} · D · t_w · 2: 1083.375 kip

This is multiplied by 2 due to two webs

Y($\bar{b}$): 20.0625

d_{rt}: 0 no concrete reinforcing steel

d_{rb}: 0 no concrete reinforcing steel

d_t: Y($\bar{b}$) + t_{rt} / 2: 20.4375 in

d_c: D - Y($\bar{b}$) + t_{tc} / 2: 20.4375 in

M_p: 50598.11 kip-in

Hybrid factor:

R_h: See Article 6.10.1.10.1

R_h: 1

Yield Moment

M_y: Smaller of M_{yc} and M_{yt}, See Article D6.2.

M_{yc}: F_{yc} · S_{xc}: 46003 kip-in

M_{yt}: F_{yt} · S_{xt}: 46003 kip-in

M_y: 46002.96 kip-in

lamda(pw(D_{cp})): smaller of

$((E/F_y)^{0.5}) / (0.54 \cdot (M_p / (R_h \cdot M_y)) - 0.09)^{0.5}$: 111.8

lamda(rw) · (D_{cp} / D_c): 161.8

lamda(pw(D_{cp})): 111.8

Web Compact?

2 · D_{cp} / t_w: 107.0

lamda(pw(D_{cp})): 111.8

Web is Compact, R_{pc} = M_p / M_{yc}

Web Plastification Factor - Comp:

R_{pc}: M_p / M_{yc}:

1.100 *Use if Web is Compact*

Article A6.2.2 - Noncompact Web Sections

Verify the webs are non-compact and not slender.

If lamda(f) < lamda(rw), then noncompact.

Slenderness ratio for web:

lamda(f): $2 \cdot D_{cp} / t_w$: 107.0026667

Limiting Slenderness ratio for noncompact web:

lamda(rw): $5.7 \cdot (E/F_y)^{0.5}$: 161.8

Noncompact vs Slender webs?

Noncompact, keep going

Web Plastification Factor - Comp:

R_{pc}: smaller of

$[1 - (1 - (R_h \cdot M_{yc} / M_p)) \cdot (\lambda(f) - \lambda(pw(D_{cp})) / (\lambda(rw) - \lambda(pw(D_{cp}))) \cdot (M_p / M_{yc})$

M_p / M_{yc}

Limiting Slenderness ratio for a compact web:

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6/25/10

$\lambda_{pw(Dc)}$	smaller of	$\lambda_{pw(Dcp)} * (Dc/Dcp)$	
$\lambda_{pw(Dcp)} * (Dc/Dcp)$		λ_{pw}	
			111.8
$\lambda_{pw(Dc)}$			111.8
$[1 - (1 - (R_h * M_y / M_p))] * ((\lambda_{pw} - \lambda_{pw(Dc)}) / (\lambda_{pw} - \lambda_{pw(Dc)})) * (M_p / M_y)$			1.109
M_p / M_y			1.100
R_{pc}			1.100

Web Plastification Factor Comp: R_{pc} (FINAL): 1.100

Nominal Flexural Resistance - comp: M_{nc}: 31589 kip-in Per Article A6.3.2

Article A6.3.3 - Lateral Torsional Buckling Resistance:

If $L_b \leq L_p$, then $M_{nc} = R_{pc} * M_y$

$L_b \leq L_p$, therefore $M_{nc} = R_{pc} * M_y$ (Same as A6.3.2)

M_{nc}: 50598 kip-in Per Article A6.3.3

Nominal Flexural Resistance - Comp: M_{nc}: 31589 kip-in

A6.4 - Flexural Resistance Based on Tension Flange Yielding

Nominal Flexural Resistance - tension: M_{nt}: R_{pt} * M_y

Web Plastification Factor - Ten: R_{pt}: See Article A6.2.1 or Article A6.2.2 as applicable.

Article A6.2.1 - Compact Web Sections

R_{pt}: M_p / M_y: 1.100 Use if Web is Compact

Article A6.2.2 - Noncompact Web Sections			
R _{pt}	smaller of	$[1 - (1 - (R_h * M_y / M_p))] * ((\lambda_{pw} - \lambda_{pw(Dc)}) / (\lambda_{pw} - \lambda_{pw(Dc)})) * (M_p / M_y)$	
		M_p / M_y	
			1.109
$[1 - (1 - (R_h * M_y / M_p))] * ((\lambda_{pw} - \lambda_{pw(Dc)}) / (\lambda_{pw} - \lambda_{pw(Dc)})) * (M_p / M_y)$			1.109
M_p / M_y			1.100
R _{pt}			1.100

R_{pt} (FINAL): 1.100

Nominal Flexural Resistance - Ten: M_{nt}: 50598 kip-in

Project: MnDOT Special Structures - 69801J - Bridge 3A Pier 4
 Date: 21-May-10
 RisaSection Name: BR3A-P4-h

Project Number: 90147
 Eng: JDF
 Checked By: *cjm*
initial s/lrld
recheck Glesho

Spreadsheet has been created for use with Box Steel Beam Caps Only.
 For sections with compact, non-compact, or slender flanges.
 For sections with compact or non-compact webs.

Yield Strengths:	F _{yc} :	36 ksi	F _{yt} :	36 ksi	F _{yw} :	36 ksi
Modulus of Elasticity:	E:	29000 ksi				
Compression Flange:	b _{fc} :	36 in	t _{fc} :	0.75 in		
Tension Flange:	b _{ft} :	36 in	t _{ft} :	0.75 in		
Webs:	D:	45.875 in	t _w :	1 in		
Clear Space between webs:		30 in				
Unbraced Length:	L _b :	108 in				
Neutral Axis:	Y-bar (Comp)	23.688 in	Y bar (Ten)	23.688 in	X-bar	18 in
Moment of Intertia:	I _{xx} :	45440 in ⁴	I _{yy} :	27880 in ⁴		
Section Modulus:	S _x (Comp)	1918.35 in ³	S _x (Ten)	1918.35 in ³	S _y	1549.03 in ³
Radius:	r _x :	17.657 in	r _y :	13.831 in		
Plastic Modulus:	Z _x :	2311.13 in ³	Z _y :	1908.13 in ³		
Torsional Constant:	J:	40.377 in ⁴				

Based on AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition, 2007, With 2008 & 2009 Interim Revisions
 Article 6.10 - I-Section Flexural Members
 Article 6.10.6 - Strength Limit State
 Article 6.10.6.2 - Flexure
 Article 6.10.6.2.3 - Composite Sections in Negative Flexure and Noncomposite Sections

If the following conditions are met, proportion the section according to the provisions for compact or noncompact web sections specified in Appendix A. Otherwise, the section shall be proportioned according to provisions specified in Article 6.10.8.

Depth of Web in Comp:	D _c :	22.938 in
Moment of Inertia Comp Flange:	I _{yc} :	2916.0 in ⁴
Moment of Inertia Tens Flange:	I _{yt} :	2916.0 in ⁴

Yield Strength Limit:	Max F _y :	36 ksi	Limit F _y :	70 ksi	OK - Keep Going
Web Slenderness Limit (slender):	2*D _c /t _w :	45.876	5.7*(E/F _{yc}) ^{0.5} :	161.8 ksi	OK - Keep Going
Flange Ratio:	I _{yc} /I _{yt} :	1	Limit:	0.3	OK - Keep Going

Appendix A6: Flexural Resistance of Straight Composite I-Sections in Negative Flexure and Straight Non-composite I-sections with Compact or Noncompact Webs
 Article A6.1 - General - Same as Article 6.10.6.2.3 above.
 Article A6.1.1 - Sections with Discretely Braced Compression Flanges

At the limit state the following requirement shall be satisfied: $M_u + (1/3) * f_l * S_{xc} \leq \phi(f) * M_{nc}$

Bending Moment - Major Axis:	M _u :	Varies, see Risa 3D
Flange Lateral Bending Stress:	f _l :	See Article 6.10.1.6

Flange lateral bending stress, f_l, may be determined directly from first-order elastic analysis in discretely braced compression flanges for which: $b \leq 1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{0.5}$

Limiting Unbraced Length:	L _p :	See Article 6.10.8.2.3
	L _p :	$1.0 * r_t * (E / F_{yc})^{0.5}$
Effective Radius of Gyration:	r _t :	$b_{fc} / (12 * (1 + (1/3) * (D_c * t_w / (b_{fc} * t_{fc}))))^{0.5}$
	r _t :	9.2 in
	L _p :	260.4 in

Moment Gradient Modifier:	C _b :	See Article 6.10.8.2.3 or Article A6.3.3, as applicable
	C _b :	1 Since M _{mid} /M ₂ > 1 at most situations. May be conservative at some locations.

Web Load-shedding Factor:	R _b :	See Article 6.10.1.10.2 1.0 if 2*D _c /t _w <= lamda (rw)
Web Slenderness Limit (noncompact):	lamda (rw):	5.7*(E/F _{yc}) ^{0.5} 161.8
	2*D _c /t _w :	45.876
	R _b :	1

Major Axis Bending to Yield Moment:	M _u /M _{yc} :	1 Assume 1.0. Conservative.
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Unbraced Limit for f _l :	L _b :	108 in	$1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{0.5}$	312.5 in	OK - Keep Going, First-order elastic analysis
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Flange Lateral Bending Stress:	f _l :	M _u /S _y First-order elastic analysis
Factored Weak Axis Bending Moment:	M _{uy} :	See Risa

Resistance Factor for Flexure:	phi(f):	1 As specified in Article 6.5.4.2
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Nominal Flexural Resistance: M_{nc}: See Article A6.3
 Nominal Flexural Resistance based on compression flange, M_{nc}, shall be taken as the smaller of the local buckling resistance determined as specified in Article A6.3.2, and the lateral torsional buckling resistance determined as specified in Article A6.3.3.

Article A6.3.2 - Local Buckling Resistance:
 Determine if the compression flange is compact:

John
6/25/10

Limiting Slenderness Ratio for Compact Flange:

Use two ratios, one for the flange between the webs, and the other for the flange overhang. See AISC Table B4.1.

Case 12: Uniform compression in flanges of rectangular box and hollow structural sections of uniform thickness subject to bending or compression.

lamda(f)	b/t:	40.00	Clear space between webs/t _{fc}
lamda(pf)	$1.12 * (E/F_y)^{0.5}$:	31.79	
lamda(rf)	$1.40 * (E/F_y)^{0.5}$:	39.74	

Case 12: Slender Flange

Case 2: Flexure in flanges of doubly and singly symmetric I-shaped built-up sections.

lamda(f)	b/t:	3.33	Flange overhang measured from mid-web/t _{fc}
lamda(pf)	$0.38 * (E/F_y)^{0.5}$:	10.79	
lamda(rf)	$0.95 * (E * k_c / F_y r)^{0.5}$:	24.77	
k _c :	$4 / (D/t_w)^{0.5}$:	0.59	but $0.35 \leq k_c \leq 0.76$
k _c :	0.59		
F _{yr} :	smaller of 3 items below:		
	0.7 * F _{yc} :	25.2	ksi
	R _h * F _{yt} * S _{xt} / S _{xc} :	36.0	ksi
	F _{yw} :	36.0	ksi
	but not less than:		
	0.5 * F _{yc} :	18.0	ksi

F_{yr}: 25.2 ksi

Case 2: Compact Flange If Case 2 Flange is Noncompact or Slender, then check lamdas used.

Slender Flange Worse condition of Case 12 and Case 2

Compression Flange:

Nominal Flexural Resistance:	M _{nc} :	$[1 - (1 - (F_y r * S_{xc}) / (R_p c * M_{yc}) * (\lambda_d(f) - \lambda_d(pf)) / (\lambda_d(rf) - \lambda_d(pf))) * R_p c * M_{yc}]$	Equation A6.3.2-1 or A6.3.2-2
Web Plastification Factor - Comp:	R _{pc} :	See Article A6.2.1 or A6.2.2, as applicable	

Article A6.2.1 - Compact Web Sections:

Determine if the web is compact:

Compact if $2 * D_{cp} / t_w \leq \lambda_d(pw(D_{cp}))$

Depth of Web in Comp at Plastic Mom:

D_{cp}: See Article D6.3.2

For non composite sections where: $F_y w * A_w \geq |F_{yc} * A_c - F_{yt} * A_t|$, $D_{cp} = D / (2 * A_w * F_y w) [F_{yt} * A_t + F_y w * A_w - F_{yc} * A_c]$, otherwise $D_{cp} = D$.

F_{yw} * A_w: 3303 kip | F_{yc} * A_c - F_{yt} * A_t: 0 kip Use $2 * D * t_w$ for A_w due to two webs

D_{cp}: 22.9 in

Limiting Slenderness Ratio for Compact Web:

lamda (pw(D_{cp})): $((E/F_y)^{0.5}) / (0.54 * (M_p / (R_h * M_y)) - 0.09)^{0.5} \leq \lambda_d(rw) * (D_{cp} / D_c)$

Plastic Moment

M_p: See Article D6.1

Article D6.1 - Plastic Moment:

M_p: See Table D6.1-2, Case I

M_p: $P_w / (2 * D) * [Y(\bar{b})^2 + (D - Y(\bar{b}))^2] + [P_{rt} * d_{rt} + P_{rb} * d_{rb} + P_t * d_t + P_c * d_c]$

Y($\bar{b}$): $(D/2) * [(P_c - P_t - P_{rt} - P_{rb}) / P_w + 1]$

P_c: F_{yc} * b_c * t_c: 972 kip

P_t: F_{yt} * b_t * t_t: 972 kip

P_{rt}: 0 no concrete reinforcing steel

P_{rb}: 0 no concrete reinforcing steel

P_w: F_{yw} * D * t_w: 3303 kip This is multiplied by 2 due to two webs

Y($\bar{b}$): 22.9375

d_{rt}: 0 no concrete reinforcing steel

d_{rb}: 0 no concrete reinforcing steel

d_t: Y($\bar{b}$) + t_t / 2 23.3125 in

d_c: D - Y($\bar{b}$) + t_c / 2 23.3125 in

M_p: 83200.78 kip-in

Hybrid factor:

R_h: See Article 6.10.1.10.1

R_h: 1

Yield Moment

M_y: Smaller of M_{yc} and M_{yt}, See Article D6.2.

M_{yc}: F_{yc} * S_{xc} 69061 kip-in

M_{yt}: F_{yt} * S_{xt} 69061 kip-in

M_y: 69060.6 kip-in

lamda (pw(D_{cp})): smaller of

$((E/F_y)^{0.5}) / (0.54 * (M_p / (R_h * M_y)) - 0.09)^{0.5}$ 90.3

lamda(rw) * (D_{cp} / D_c) 161.8

lamda (pw(D_{cp})): 90.3

Web Compact?

$2 * D_{cp} / t_w$ 45.9

lamda (pw(D_{cp})): 90.3

Web is Compact, R_{pc} = M_p / M_{yc}

Web Plastification Factor - Comp:

R_{pc}: M_p / M_{yc}: 1.205 Use if Web is Compact

Article A6.2.2 - Noncompact Web Sections

Verify the webs are non-compact and not slender.

If $\lambda_d(w) < \lambda_d(rw)$, then noncompact.

Slenderness ratio for web: lamda(w): $2 * D_{cp} / t_w$ 45.876

Limiting Slenderness ratio for noncompact web: lamda(rw): $5.7 * (E/F_y)^{0.5}$ 161.8

Noncompact vs Slender webs?

Noncompact, keep going

Web Plastification Factor - Comp:

R_{pc}: smaller of $[1 - (R_h * M_{yc} / M_p) * (\lambda_d(w) - \lambda_d(pw(D_{cp}))) / (\lambda_d(rw) - \lambda_d(pw(D_{cp}))) * M_p / M_{yc}]$ and M_p / M_{yc}

Limiting Slenderness ratio for a compact web:

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5/25/10

$\lambda_{pw(Dc)}$	smaller of	$\lambda_{pw(Dcp)} * (Dc/Dcp)$	
$\lambda_{pw(Dcp)} * (Dc/Dcp)$		λ_{pw}	
$\lambda_{pw(Dc)}$		90.3	
$\lambda_{pw(Dc)}$		90.3	
$[1 - (1 - (R_h * M_y / M_p)) * ((\lambda(w) - \lambda_{pw(Dc)}) / (\lambda_{rw} - \lambda_{pw(Dc)}))] * (M_p / M_y)$			1.332
M_p / M_y			1.205
Rpc		1.205	

Web Plastification Factor Comp: Rpt (FINAL): 1.205

Nominal Flexural Resistance - comp: Mnc: 47181 kip-in Per Article A6.3.2

Article A6.3.3 - Lateral Torsional Buckling Resistance:

If $L_b \leq L_p$, then $M_{nc} = R_{pc} * M_{yc}$
 $L_b \leq L_p$, therefore $M_{nc} = R_{pc} * M_{yc}$ (Same as A6.3.2)
Mnc: 83201 kip-in Per Article A6.3.3

Nominal Flexural Resistance - Comp: Mnc: 47181 kip-in

A6.4 - Flexural Resistance Based on Tension Flange Yielding

Nominal Flexural Resistance - tension: Mnt: $R_{pt} * M_{yt}$
Web Plastification Factor - Ten: Rpt: See Article A6.2.1 or Article A6.2.2 as applicable.

Article A6.2.1 - Compact Web Sections
Rpt: M_p / M_{yt} : 1.205 Use if Web is Compact

Article A6.2.2 - Noncompact Web Sections			
Rpt:	smaller of	$[1 - (1 - (R_h * M_{yt} / M_p)) * ((\lambda(w) - \lambda_{pw(Dc)}) / (\lambda_{rw} - \lambda_{pw(Dc)}))] * (M_p / M_{yt})$	
		M_p / M_{yt}	
$[1 - (1 - (R_h * M_{yt} / M_p)) * ((\lambda(w) - \lambda_{pw(Dc)}) / (\lambda_{rw} - \lambda_{pw(Dc)}))] * (M_p / M_{yt})$			1.332
M_p / M_{yt}			1.205
Rpt:		1.205	

Rpt (FINAL): 1.205

Nominal Flexural Resistance - Ten: Mnt: 83201 kip-in

Project: MnDOT Special Structures - 69801J - Bridge 3A Pier 4
 Date: 21-May-10
 RisaSection Name: BR3A-P4-i

Project Number: 90147
 Eng: JDF
 Checked By: com

Initial 5/17/10
 recheck 6/25/10

Spreadsheet has been created for use with Box Steel Beam Caps Only.
 For sections with compact, non-compact, or slender flanges.
 For sections with compact or non-compact webs.

Yield Strengths:	F _{yc} :	36 ksi	F _{yt} :	36 ksi	F _{yw} :	36 ksi
Modulus of Elasticity:	E:	29000 ksi				
Compression Flange:	b _{fc} :	36 in	t _{fc} :	0.75 in		
Tension Flange:	b _{tc} :	36 in	t _{tc} :	0.75 in		
Webs:	D:	44.938 in	t _w :	0.375 in		
Clear Space between webs:		30 in				
Unbraced Length:	L _b :	108 in				
Neutral Axis:	Y-bar (Comp)	23.219 in	Y bar (Ten)	23.219 in	X-bar	18 in
Moment of Inertia:	I _{xx}	33850 in ⁴	I _{yy}	13610 in ⁴		
Section Modulus:	S _x (Comp)	1458.02 in ³	S _x (Ten)	1458.02 in ³	S _y	755.91 in ³
Radius:	r _x	19.647 in	r _y	12.456 in		
Plastic Modulus:	Z _x	1612.2 in ³	Z _y	997.87 in ³		
Torsional Constant:	J	11.625 in ⁴				

Based on AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition, 2007, With 2008 & 2009 Interim Revisions
 Article 6.10 - I-Section Flexural Members
 Article 6.10.6 - Strength Limit State
 Article 6.10.6.2 - Flexure
 Article 6.10.6.2.3 - Composite Sections in Negative Flexure and Noncomposite Sections

If the following conditions are met, proportion the section according to the provisions for compact or noncompact web sections specified in Appendix A. Otherwise, the section shall be proportioned according to provisions specified in Article 6.10.8.

Depth of Web in Comp:	D _c :	22.469 in
Moment of Inertia Comp Flange:	I _{yc} :	2916.0 in ⁴
Moment of Inertia Tens Flange:	I _{yt} :	2916.0 in ⁴

Yield Strength Limit:	Max F _y :	36 ksi	Limit F _y :	70 ksi	OK - Keep Going
Web Slenderness Limit (slender):	2*D _c /t _w :	119.8347	5.7*(E/F _{yc}) ^{0.5} :	161.8 ksi	OK - Keep Going
Flange Ratio:	I _{yc} /I _{yt} :	1	Limit:	0.3	OK - Keep Going

Appendix A6: Flexural Resistance of Straight Composite I-Sections in Negative Flexure and Straight Non-composite I-sections with Compact or Noncompact Webs
 Article A6.1 - General - Same as Article 6.10.6.2.3 above.
 Article A6.1.1 - Sections with Discretely Braced Compression Flanges

At the limit state the following requirement shall be satisfied: $M_u + (1/3) * f_l * S_{xc} \leq \phi(f) * M_{nc}$

Bending Moment - Major Axis:	M _u :	Varies, see Risa 3D
Flange Lateral Bending Stress:	f _l :	See Article 6.10.1.6

Flange lateral bending stress, f_l , may be determined directly from first-order elastic analysis in discretely braced compression flanges for which: $L_b \leq 1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{0.5}$

Limiting Unbraced Length:	L _p :	See Article 6.10.8.2.3
	L _p :	1.0 * r _t * (E/F _{yc}) ^{0.5}
Effective Radius of Gyration:	r _t :	$b_{fc} / (12 * (1 + (1/3) * (D_c * t_w / (b_{tc} * t_{fc}))))^{0.5}$
	r _t :	9.9 in
	L _p :	280.7 in

Moment Gradient Modifier:	C _b :	See Article 6.10.8.2.3 or Article A6.3.3, as applicable
	C _b :	1 Since $M_{mid} / M_2 > 1$ at most situations. May be conservative at some locations.

Web Load-shedding Factor:	R _b :	See Article 6.10.1.10.2	1.0 if 2*D _c /t _w ≤ λ _{md} (r _w)
Web Slenderness Limit (noncompact):	λ _{md} (r _w):	5.7*(E/F _{yc}) ^{0.5}	161.8
	2*D _c /t _w :	119.8347	
	R _b :	1	

Major Axis Bending to Yield Moment:	M _u /M _{yc} :	1 Assume 1.0. Conservative.
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Unbraced Limit for f _l :	L _b :	108 in	1.2 * L _p * (C _b * R _b / (M _u / M _{yc})) ^{0.5}	336.9 in	OK - Keep Going, First-order elastic analysis
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Flange Lateral Bending Stress:	f _l :	M _{uy} /S _y First-order elastic analysis
Factored Weak Axis Bending Moment:	M _{uy} :	See Risa

Resistance Factor for Flexure:	φ(f):	1 As specified in Article 6.5.4.2
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Nominal Flexural Resistance: M_{nc}: See Article A6.3
 Nominal Flexural Resistance based on compression flange, M_{nc}, shall be taken as the smaller of the local buckling resistance determined as specified in Article A6.3.2, and the lateral torsional buckling resistance determined as specified in Article A6.3.3.

Article A6.3.2 - Local Buckling Resistance:
 Determine if the compression flange is compact:

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6/25/10

Limiting Slenderness Ratio for Compact Flange:

Use two ratios, one for the flange between the webs, and the other for the flange overhang. See AISC Table B4.1.

Case 12: Uniform compression in flanges of rectangular box and hollow structural sections of uniform thickness subject to bending or compression.

lamda(f)	b/t:	40.00	Clear space between webs/t _{fc}
lamda(pf)	$1.12*(E/Fy)^{.5}$:	31.79	
lamda(rf)	$1.40*(E/Fy)^{.5}$:	39.74	

Case 12: Slender Flange

Case 2: Flexure in flanges of doubly and singly symmetric I-shaped built-up sections.

lamda(f)	b/t:	3.75	Flange overhang measured from mid-web/t _{fc}
lamda(pf)	$0.38*(E/Fy)^{.5}$:	10.79	
lamda(rf)	$0.95*(E*k_c/Fy)^{.5}$:	19.48	
k _c :	$4/(D/t_w)^{.5}$:	0.37	but $0.35 \leq k_c \leq 0.76$
k _c :	0.37		

F_{yr}: smaller of 3 items below:

0.7*F _{yc} :	25.2	ksi
R _h *F _{yt} *S _{xt} /S _{xc} :	36.0	ksi
F _{yw} :	36.0	ksi
but not less than:		
0.5*F _{yc} :	18.0	ksi

F_{yr}: 25.2 ksi

Case 2: Compact Flange

If Case 2 Flange is Noncompact or Slender, then check lamdas used.

Slender Flange

Worse condition of Case 12 and Case 2

Compression Flange:

Nominal Flexural Resistance:

M_{nc}: $[1 - (F_{yr}*S_{xc})/(R_{pc}*M_{yc})]*(lamda(f) - lamda(pf))/(lamda(rf) - lamda(pf))]*R_{pc}*M_{yc}$

Equation A6.3.2-1 or A6.3.2-2

Web Plastification Factor - Comp:

R_{pc}: See Article A6.2.1 or A6.2.2, as applicable

Article A6.2.1 - Compact Web Sections:

Determine if the web is compact:

Compact if $2*D_{cp}/t_w \leq lamda(pw(D_{cp}))$

Depth of Web in Comp at Plastic Mom:

D_{cp}: See Article D6.3.2

For non composite sections where: $F_{yw}*A_w \geq [F_{yc}*A_c - F_{yt}*A_t]$, $D_{cp} = D/(2*A_w*F_{yw})[F_{yt}*A_t + F_{yw}*A_w - F_{yc}*A_c]$, otherwise $D_{cp} = D$.

F_{yw}*A_w: 1213.326 kip | F_{yc}*A_c-F_{yt}*A_t: 0 kip

Use 2*D*t_w for A_w due to two webs

D_{cp}: 22.5 in

Limiting Slenderness Ratio for Compact Web:

lamda(pw(D_{cp})): $((E/F_{yc})^{.5})/(0.54*(M_p/(R_h*M_y)) - 0.09)^{.2} \leq lamda(rw)*(D_{cp}/D_c)$

Plastic Moment

M_p: See Article D6.1

Article D6.1 - Plastic Moment:

M_p: See Table D6.1-2, Case I

M_p: $P_w/(2*D)*[Y(\bar{bar})^2 + (D - Y(\bar{bar}))^2] + [P_{rt}*d_{rt} + P_{rb}*d_{rb} + P_t*d_t + P_c*d_c]$

Y($\bar{bar}$): $(D/2)*[(P_c - P_t - P_{rt} - P_{rb})/P_w + 1]$

P_c: F_{yc}*b_c*t_c: 972 kip

P_t: F_{yt}*b_t*t_t: 972 kip

P_{rt}: 0 no concrete reinforcing steel

P_{rb}: 0 no concrete reinforcing steel

P_w: F_{yw}*D*t_w*2: 1213.326 kip

This is multiplied by 2 due to two webs

Y($\bar{bar}$): 22.469

d_{rt}: 0 no concrete reinforcing steel

d_{rb}: 0 no concrete reinforcing steel

d_t: Y($\bar{bar}$)+t_t/2: 22.844 in

d_c: D-Y($\bar{bar}$)+t_c/2: 22.844 in

M_p: 58039.85 kip-in

Hybrid factor:

R_h: See Article 6.10.1.10.1

R_h: 1

Yield Moment

M_y: Smaller of M_{yc} and M_{yt}, See Article D6.2.

M_{yc}: F_{yc}*S_{xc}: 52489 kip-in

M_{yt}: F_{yt}*S_{xt}: 52489 kip-in

M_y: 52488.72 kip-in

lamda(pw(D_{cp})): smaller of

$((E/F_{yc})^{.5})/(0.54*(M_p/(R_h*M_y)) - 0.09)^{.2}$: 110.4

lamda(rw)*(D_{cp}/D_c): 161.8

lamda(pw(D_{cp})): 110.4

Web Compact?

2*D_{cp}/t_w: 119.8

lamda(pw(D_{cp})): 110.4

Web is not compact, See Article A6.2.2

Web Plastification Factor - Comp: R_{pc}: M_p/M_{yc}: 1.106

Article A6.2.2 - Noncompact Web Sections

Verify the webs are non-compact and not slender.

If lamda(w) < lamda(rw), then noncompact.

Slenderness ratio for web:

lamda(w): 2*D_c/t_w: 119.8346667

Limiting Slenderness ratio for noncompact web:

lamda(rw): $5.7*(E/F_{yc})^{.5}$: 161.8

Noncompact vs Slender webs?

Noncompact, keep going

Web Plastification Factor - Comp:

R_{pc}: smaller of

$[1 - (R_h*M_{yc}/M_p)]*((lamda(w) - lamda(pw(D_c)))/(lamda(rw) - lamda(pw(D_c))))*(M_p/M_{yc})$
M_p/M_{yc}

Limiting Slenderness ratio for a compact web:

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lamda(pw(Dc)):	smaller of	lamda(pw(Dcp))*(Dc/Dcp)	
		lamda(rw)	
lamda(pw(Dcp))*(Dc/Dcp)			110.4
lamda(pw(Dc)):			110.4
[1-(1-(Rh*Myc/Mp))*((lamda(w)-lamda(pw(Dc)))/(lamda(rw)-lamda(pw(Dc))))*(Mp/Myc)			1.086
Mp/Myc			1.106

Rpc: 1.086 Use if Web is Noncompact

Web Plastification Factor Comp: Rpc (FINAL): 1.086

Nominal Flexural Resistance - comp: Mnc: 36067 kip-in Per Article A6.3.2

Article A6.3.3 - Lateral Torsional Buckling Resistance:

If $L_b \leq L_p$, then $M_{nc} = R_{pc} * M_{yc}$
 $L_b \leq L_p$, therefore $M_{nc} = R_{pc} * M_{yc}$ (Same as A6.3.2)
 Mnc: 57018 kip-in Per Article A6.3.3

Nominal Flexural Resistance - Comp: Mnc: 36067 kip-in

A6.4 - Flexural Resistance Based on Tension Flange Yielding

Nominal Flexural Resistance - tension: Mnt: Rpt*Myt
 Web Plastification Factor - Ten: Rpt: See Article A6.2.1 or Article A6.2.2 as applicable.

Article A6.2.1 - Compact Web Sections

Rpt: Mp/Myt 1.106 Use if Web is Noncompact

Article A6.2.2 - Noncompact Web Sections

Rpt:	smaller of	[1-(1-(Rh*Myt/Mp))*((lamda(w)-lamda(pw(Dc)))/(lamda(rw)-lamda(pw(Dc))))*(Mp/Myt)	
		Mp/Myt	
[1-(1-(Rh*Myt/Mp))*((lamda(w)-lamda(pw(Dc)))/(lamda(rw)-lamda(pw(Dc))))*(Mp/Myt)			1.086
Mp/Myt			1.106
Rpt:	1.086	Use if Web is Noncompact	
Rpt (FINAL):	1.086		

Nominal Flexural Resistance - Ten: Mnt: 57018 kip-in

Project: MnDOT Special Structures - 69801J - Bridge 3A Pier 4
 Date: 21-May-10
 RisaSection Name: BR3A-P4-j

Project Number: 90147
 Eng: JDF

Checked By: *CSM*
initial 5/17/10
recheck 6/23/10

Spreadsheet has been created for use with Box Steel Beam Caps Only.
 For sections with compact, non-compact, or slender flanges.
 For sections with compact or non-compact webs.

Yield Strengths:	F _{yc} :	36 ksi	F _{yt} :	36 ksi	F _{yw} :	36 ksi
Modulus of Elasticity:	E:	29000 ksi				
Compression Flange:	b _{fc} :	42 in	t _{fc} :	3 in		
Tension Flange:	b _{tc} :	36 in	t _{ft} :	0.75 in		
Webs:	D:	43.625 in	tw:	1 in		
Clear Space between webs:		30 in				
Unbraced Length:	L _b :	49.2 in				
Neutral Axis:	Y-bar (Comp)	15.081 in	Y bar (Ten)	32.294 in	X-bar	21 in
Moment of Inertia:	I _{xx}	72950 in ⁴	I _{yy}	42410 in ⁴	S _y	2019.38 in ³
Section Modulus:	S _x (Comp)	4837.23 in ³	S _x (Ten)	2258.85 in ³		
Radius:	r _x	17.425 in	r _y	13.286 in		
Plastic Modulus:	Z _x	3279.32 in ³	Z _y	2918.38 in ³		
Torsional Constant:	J	396.09 in ⁴				

Based on AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition, 2007, With 2008 & 2009 Interim Revisions

Article 6.10 - I-Section Flexural Members

Article 6.10.6 - Strength Limit State

Article 6.10.6.2 - Flexure

Article 6.10.6.2.3 - Composite Sections in Negative Flexure and Noncomposite Sections

If the following conditions are met, proportion the section according to the provisions for compact or noncompact web sections specified in Appendix A. Otherwise, the section shall be proportioned according to provisions specified in Article 6.10.8.

Depth of Web in Comp:	D _c :	12.081 in
Moment of Inertia Comp Flange:	I _{yc} :	18522.0 in ⁴
Moment of Inertia Tens Flange:	I _{yt} :	2916.0 in ⁴

Yield Strength Limit:	Max F _y :	36 ksi	Limit F _y :	70 ksi	OK - Keep Going
Web Slenderness Limit (slender):	2*D _c /tw:	24.162	5.7*(E/F _{yc}) ^{0.5} :	161.8 ksi	OK - Keep Going
Flange Ratio:	I _{yc} /I _{yt} :	6.351852	Limit:	0.3	OK - Keep Going

Appendix A6: Flexural Resistance of Straight Composite I-Sections in Negative Flexure and Straight Non-composite I-sections with Compact or Noncompact Webs

Article A6.1 - General - Same as Article 6.10.6.2.3 above.

Article A6.1.1 - Sections with Discretely Braced Compression Flanges

At the limit state the following requirement shall be satisfied: $M_u + (1/3) * f_l * S_{xc} \leq \phi(f) * M_{nc}$

Bending Moment - Major Axis:	M _u :	Varies, see Risa 3D
Flange Lateral Bending Stress:	f _l :	See Article 6.10.1.6

Flange lateral bending stress, f_l, may be determined directly from first-order elastic analysis in discretely braced compression flanges for which: $L_b \leq 1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{0.5}$

Limiting Unbraced Length:	L _p :	See Article 6.10.8.2.3
	L _p :	1.0 * r _t * (E/F _{yc}) ^{0.5}
Effective Radius of Gyration:	r _t :	$b_{fc} / (12 * (1 + (1/3) * (D_c * t_w / (b_{tc} * t_{fc}))))^{0.5}$
	r _t :	11.9 in
	L _p :	338.7 in

Moment Gradient Modifier:	C _b :	See Article 6.10.8.2.3 or Article A6.3.3, as applicable
	C _b :	1 Since M _{mid} /M ₂ > 1 at most situations. May be conservative at some locations.

Web Load-shedding Factor:	R _b :	See Article 6.10.1.10.2 1.0 if 2*D _c /tw ≤ λ _{md} (rw)
Web Slenderness Limit (noncompact):	λ _{md} (rw):	5.7*(E/F _{yc}) ^{0.5} 161.8
	2*D _c /tw:	24.162
	R _b :	1

Major Axis Bending to Yield Moment:	M _u /M _{yc} :	1 Assume 1.0. Conservative.
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Unbraced Limit for f _l :	L _b :	49.2 in	1.2 * L _p * (C _b * R _b / (M _u / M _{yc})) ^{0.5}	406.5 in	OK - Keep Going, First-order elastic analysis
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Flange Lateral Bending Stress:	f _l :	M _{uy} /S _y First-order elastic analysis
Factored Weak Axis Bending Moment:	M _{uy} :	See Risa

Resistance Factor for Flexure:	φ(f):	1 As specified in Article 6.5.4.2
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Nominal Flexural Resistance:	M _{nc} :	See Article A6.3
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Nominal Flexural Resistance based on compression flange, M_{nc}, shall be taken as the smaller of the local buckling resistance determined as specified in Article A6.3.2, and the lateral torsional buckling resistance determined as specified in Article A6.3.3.

Article A6.3.2 - Local Buckling Resistance:

Determine if the compression flange is compact:

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Limiting Slenderness Ratio for Compact Flange:

Use two ratios, one for the flange between the webs, and the other for the flange overhang. See AISC Table B4.1.

Case 12: Uniform compression in flanges of rectangular box and hollow structural sections of uniform thickness subject to bending or compression.

lamda(f)	b/t:	10.00	Clear space between webs/t _{fc}
lamda(pf)	1.12*(E/Fy) ^{0.5} :	31.79	
lamda(rf)	1.40*(E/Fy) ^{0.5} :	39.74	

Case 12: Compact Flange

Case 2: Flexure in flanges of doubly and singly symmetric I-shaped built-up sections.

lamda(f)	b/t:	1.83	Flange overhang measured from mid-web/t _{fc}
lamda(pf)	0.38*(E/Fy) ^{0.5} :	10.79	
lamda(rf)	0.95*(E*k _c /Fy) ^{0.5} :	29.67	

k_c: 4/(D/t_w)^{0.5}: 0.61 but 0.35 ≤ k_c ≤ 0.76

k_c: 0.61

F_{yr}: smaller of 3 items below:

0.7*F _{yc} :	25.2	ksi
Rh*F _{yt} *S _{xt} /S _{xc} :	16.8	ksi
F _{yw} :	36.0	ksi
but not less than:		
0.5*F _{yc} :	18.0	ksi

F_{yr}: 18.0 ksi

Case 2: Compact Flange If Case 2 Flange is Noncompact or Slender, then check lamdas used.

Compact Flange Worse condition of Case 12 and Case 2

Compression Flange:

Nominal Flexural Resistance:

M_{nc}: M_{nc} = R_{pc}*M_{yc}

Equation A6.3.2-1 or A6.3.2-2

Web Plastification Factor - Comp:

R_{pc}: See Article A6.2.1 or A6.2.2, as applicable

Article A6.2.1 - Compact Web Sections:

Determine if the web is compact:

Compact if 2*D_{cp}/t_w ≤ lamda (pw(D_{cp}))

Depth of Web in Comp at Plastic Mom:

D_{cp}: See Article D6.3.2

For non composite sections where: F_{yw}*A_w ≥ |F_{yc}*A_c-F_{yt}*A_t|, D_{cp}=D/(2*A_w*F_{yw})[F_{yt}*A_t+F_{yw}*A_w-F_{yc}*A_c], otherwise D_{cp}=D.

F_{yw}*A_w: 3141 kip |F_{yc}*A_c-F_{yt}*A_t|: 3564 kip

Use 2*D*t_w for A_w due to two webs

D_{cp}: 43.6 in

Limiting Slenderness Ratio for Compact Web:

lamda (pw(D_{cp})): ((E/Fy)^{0.5})/(0.54*(M_p/(Rh*M_y))-0.09)² ≤ lamda(rw)*(D_{cp}/D_c)

Plastic Moment

M_p: See Article D6.1

Article D6.1 - Plastic Moment:

M_p: See Table D6.1-2, Case I

M_p: P_w/(2*D)*[Y($\bar{y}$)²+{D-Y($\bar{y}$)²]+[P_{rt}*d_{rt}+P_{rb}*d_{rb}+P_t*d_t+P_c*d_c]

Y($\bar{y}$): (D/2)*[(P_c-P_t-P_{rt}-P_{rb})/P_w+1]

P_c: F_{yc}*b_c*t_c: 4536 kip

P_t: F_{yt}*b_t*t_t: 972 kip

P_{rt}: 0 no concrete reinforcing steel

P_{rb}: 0 no concrete reinforcing steel

P_w: F_{yw}*D*t_w²: 3141 kip

This is multiplied by 2 due to two webs

Y($\bar{y}$): 46.5625

d_{rt}: 0 no concrete reinforcing steel

d_{rb}: 0 no concrete reinforcing steel

d_t: Y($\bar{y}$)+t_t/2 46.9375 in

d_c: D-Y($\bar{y}$)+t_c/2 -1.4375 in

M_p: 117463.8 kip-in

Hybrid factor:

R_h: See Article 6.10.1.10.1

R_h: 1

Yield Moment

M_y: Smaller of M_{yc} and M_{yt}, See Article D6.2.

M_{yc}: F_{yc}*S_{xc} 174140 kip-in

M_{yt}: F_{yt}*S_{xt} 81319 kip-in

M_y: 81318.6 kip-in

lamda (pw(D_{cp})): smaller of

((E/Fy)^{0.5})/(0.54*(M_p/(Rh*M_y))-0.09)² 59.6

lamda(rw)*(D_{cp}/D_c) 584.2

lamda (pw(D_{cp})): 59.6

Web Compact?

2*D_{cp}/t_w 87.3

lamda (pw(D_{cp})): 59.6

Web is not compact, See Article A6.2.2

Web Plastification Factor - Comp:	R _{pc} :	M _p /M _{yc} :	0.675 (see Article 6.10.1.10.1)
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Article A6.2.2 - Noncompact Web Sections

Verify the webs are non-compact and not slender.

If lamda(w) < lamda(rw), then noncompact.

Slenderness ratio for web:

lamda(w): 2*D_c/t_w: 24.162

Limiting Slenderness ratio for noncompact web:

lamda(rw): 5.7*(E/Fy)^{0.5}: 161.8

Noncompact vs Slender webs?

Noncompact, keep going

Web Plastification Factor - Comp:

R_{pc}: smaller of

[1-(1-(Rh*M_{yc}/M_p))*((lamda(w)-lamda(pw(D_c)))/(lamda(rw)-lamda(pw(D_c))))]*(M_p/M_{yc})
M_p/M_{yc}

Limiting Slenderness ratio for a compact web:

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lamda(pw(Dc)):	smaller of	lamda(pw(Dcp))*(Dc/Dcp)	
		lamda(rw)	
lamda(pw(Dcp))*(Dc/Dcp)		16.5	
lamda(pw(Dc)):		16.5	
[1-(1-(Rh*Myc/Mp))*((lamda(w)-lamda(pw(Dc)))/(lamda(rw)-lamda(pw(Dc))))*(Mp/Myc)			0.692
Mp/Myc			0.675

Rpc: 0.675 Use if Web is Noncompact

Web Plastification Factor Comp: Rpc (FINAL): 0.675

Nominal Flexural Resistance - comp: Mnc: 117464 kip-in Per Article A6.3.2

Article A6.3.3 - Lateral Torsional Buckling Resistance:

If $L_b \leq L_p$, then $M_{nc} = R_{pc} * M_{yc}$
 $L_b \leq L_p$, therefore $M_{nc} = R_{pc} * M_{yc}$ (Same as A6.3.2)
 Mnc: 117464 kip-in Per Article A6.3.3

Nominal Flexural Resistance - Comp: Mnc: 117464 kip-in

A6.4 - Flexural Resistance Based on Tension Flange Yielding

Nominal Flexural Resistance - tension: Mnt: Rpt*Myt
 Web Plastification Factor - Ten: Rpt: See Article A6.2.1 or Article A6.2.2 as applicable.

Article A6.2.1 - Compact Web Sections
 Rpt: Mp/Myt 1.444 Use if Web is Noncompact

Article A6.2.2 - Noncompact Web Sections
 Rpt: smaller of [1-(1-(Rh*Myt/Mp))*((lamda(w)-lamda(pw(Dc)))/(lamda(rw)-lamda(pw(Dc))))*(Mp/Myt)
 Mp/Myt
 [1-(1-(Rh*Myt/Mp))*((lamda(w)-lamda(pw(Dc)))/(lamda(rw)-lamda(pw(Dc))))*(Mp/Myt) 1.421
 Mp/Myt 1.444
 Rpt: 1.421 Use if Web is Noncompact
 Rpt (FINAL): 1.421

Nominal Flexural Resistance - Ten: Mnt: 115559 kip-in

Project: MnDOT Special Structures - 69801J - Bridge 3A Pier 4
 Date: 22-Feb-10
 RisaSection Name: BR3A-P4-c

Project Number: 90147
 Eng: JDF
 Checked By:

5/2/10

Spreadsheet has been created for use with Box Steel Beam Caps Only.
 For sections with compact, non-compact, or slender flanges.
 For sections with compact or non-compact webs.

Yield Strengths:	F _{yc} :	36 ksi	F _{yt} :	36 ksi	F _{yw} :	36 ksi
Modulus of Elasticity:	E:	29000 ksi				
Compression Flange:	b _{fc} :	36 in	t _{fc} :	0.75 in		
Tension Flange:	b _{tc} :	36 in	t _{tc} :	0.75 in		
Webs:	D:	40.325 in	t _w :	0.375 in		
Clear Space between webs:		30 in				
Unbraced Length:	L _b :	98.05 in				
Neutral Axis:	Y-bar (Comp)	20.813 in	Y bar (Ten)	20.813 in	X-bar	18 in
Moment of Inertia:	I _{xx}	26600 in ⁴	I _{yy}	12770 in ⁴		
Section Modulus:	S _x (Comp)	1277.86 in ³	S _x (Ten)	1277.86 in ³	S _y	709.65 in ³
Radius:	r _x	17.784 in	r _y	12.325 in		
Plastic Modulus:	Z _x	1405.5 in ³	Z _y	943.05 in ³		
Torsional Constant:	J	11.455 in ⁴				

Based on AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition, 2007, With 2008 & 2009 Interim Revisions

Article 6.10 - I-Section Flexural Members

Article 6.10.6 - Strength Limit State

Article 6.10.6.2 - Flexure

Article 6.10.6.2.3 - Composite Sections in Negative Flexure and Noncomposite Sections

If the following conditions are met, proportion the section according to the provisions for compact or noncompact web sections specified in Appendix A. Otherwise, the section shall be proportioned according to provisions specified in Article 6.10.8.

Depth of Web in Comp:	D _c :	20.063 in
Moment of Inertia Comp Flange:	I _{yc} :	2916.0 in ⁴
Moment of Inertia Tens Flange:	I _{yt} :	2916.0 in ⁴

Yield Strength Limit:	Max F _y :	36 ksi	Limit F _y :	70 ksi	OK - Keep Going
Web Slenderness Limit (slender):	2*D _c /t _w :	107.0027	5.7*(E/F _{yc}) ^{0.5} :	161.8 ksi	OK - Keep Going
Flange Ratio:	I _{yc} /I _{yt} :	1	Limit:	0.3	OK - Keep Going

Appendix A6: Flexural Resistance of Straight Composite I-Sections in Negative Flexure and Straight Non-composite I-sections with Compact or Noncompact Webs

Article A6.1 - General - Same as Article 6.10.6.2.3 above.

Article A6.1.1 - Sections with Discretely Braced Compression Flanges

At the limit state the following requirement shall be satisfied: $M_u + (1/3) * f_l * S_{xc} \leq \phi(f) * M_{nc}$

Bending Moment - Major Axis:	M _u :	Varies, see Risa 3D
Flange Lateral Bending Stress:	f _l :	See Article 6.10.1.6

Flange lateral bending stress, f_l, may be determined directly from first-order elastic analysis in discretely braced compression flanges for which: $b \leq 1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{0.5}$

Limiting Unbraced Length:	L _p :	See Article 6.10.8.2.3
	L _p :	1.0 * r _t * (E/F _{yc}) ^{0.5}
Effective Radius of Gyration:	r _t :	b _{tc} / (12 * (1 + (1/3) * (D _c * t _w / (b _{tc} * t _{fc})))) ^{0.5}
	r _t :	9.9 in
	L _p :	282.1 in

Moment Gradient Modifier:	C _b :	See Article 6.10.8.2.3 or Article A6.3.3, as applicable
	C _b :	1 Since M _{mid} /M ₂ > 1 at most situations. May be conservative at some locations.

Web Load-shedding Factor:	R _b :	See Article 6.10.1.10.2	1.0 if 2*D _c /t _w ≤ λ _{md} (rw)
Web Slenderness Limit (noncompact):	λ _{md} (rw):	5.7*(E/F _{yc}) ^{0.5}	161.8
	2*D _c /t _w :	107.0027	
	R _b :	1	

Major Axis Bending to Yield Moment:	M _u /M _{yc} :	1 Assume 1.0. Conservative.
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Unbraced Limit for f _l :	L _b :	98.05 in	1.2 * L _p * (C _b * R _b / (M _u / M _{yc})) ^{0.5}	338.6 in	OK - Keep Going, First-order elastic analysis
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Flange Lateral Bending Stress:	f _l :	M _{uy} /S _y	First-order elastic analysis
Factored Weak Axis Bending Moment:	M _{uy} :	See Risa	

Resistance Factor for Flexure:	φ(f):	1 As specified in Article 6.5.4.2
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Nominal Flexural Resistance:	M _{nc} :	See Article A6.3
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Nominal Flexural Resistance based on compression flange, M_{nc}, shall be taken as the smaller of the local buckling resistance determined as specified in Article A6.3.2, and the lateral torsional buckling resistance determined as specified in Article A6.3.3.

Article A6.3.2 - Local Buckling Resistance:

Determine if the compression flange is compact:

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Limiting Slenderness Ratio for Compact Flange:

Use two ratios, one for the flange between the webs, and the other for the flange overhang. See AISC Table B4.1.

Case 12: Uniform compression in flanges of rectangular box and hollow structural sections of uniform thickness subject to bending or compression.

$\lambda_{md}(f)$	b/t	40.00 <i>Clear space between webs/t_{fc}</i>
$\lambda_{md}(pf)$	$1.12*(E/F_y)^{.5}$	31.79
$\lambda_{md}(rf)$	$1.40*(E/F_y)^{.5}$	39.74

Case 12: Slender Flange

Case 2: Flexure in flanges of doubly and singly symmetric I-shaped built-up sections.

$\lambda_{md}(f)$	b/t	3.75 <i>Flange overhang measured from mid-web/t_{fc}</i>
$\lambda_{md}(pf)$	$0.38*(E/F_y)^{.5}$	10.79
$\lambda_{md}(rf)$	$0.95*(E*k_c/F_y)^{.5}$	20.04
k_c	$4/(D/t_w)^{.5}$	0.39 but $0.35 \leq k_c \leq 0.76$
k_c	0.39	

F_{yr}: smaller of 3 items below:

$0.7*F_{yc}$	25.2 ksi
$R_h*F_{yt}*S_{xt}/S_{xc}$	36.0 ksi
F _{yw}	36.0 ksi
but not less than:	
$0.5*F_{yc}$	18.0 ksi

F_{yr}: 25.2 ksi

Case 2: Compact Flange

If Case 2 Flange is Noncompact or Slender, then check λ_{md} s used.

Slender Flange: Worse condition of Case 12 and Case 2

Compression Flange:

Nominal Flexural Resistance:

M_{nc}: $[1-(1-(F_{yr}*S_{xc})/(R_{pc}*M_{yc}))*(\lambda_{md}(f)-\lambda_{md}(pf))/(\lambda_{md}(rf)-\lambda_{md}(pf))]*R_{pc}*M_{yc}$

Equation A6.3.2-1 or A6.3.2-2

Web Plastification Factor - Comp:

R_{pc}: See Article A6.2.1 or A6.2.2, as applicable

Article A6.2.1 - Compact Web Sections:

Determine if the web is compact:

Compact if $2*D_{cp}/t_w \leq \lambda_{md}(pw(D_{cp}))$

Depth of Web in Comp at Plastic Mom:

D_{cp}: See Article D6.3.2For non composite sections where: $F_{yw}*A_w \geq [F_{yc}*A_c - F_{yt}*A_t]$, $D_{cp} = D/(2*A_w/F_{yw})[F_{yt}*A_t + F_{yw}*A_w - F_{yc}*A_c]$, otherwise $D_{cp} = D$.F_{yw}*A_w: 1083.375 kip | F_{yc}*A_c-F_{yt}*A_t: 0 kipUse $2*D*t_w$ for A_w due to two websD_{cp}: 20.1 in

Limiting Slenderness Ratio for Compact Web:

 $\lambda_{md}(pw(D_{cp}))$: $((E/F_y)^{.5})/(0.54*(M_p/(R_h*M_y)) - 0.09)^{.2} \leq \lambda_{md}(rw)*(D_{cp}/D_c)$
M_p: See Article D6.1

Plastic Moment

Article D6.1 - Plastic Moment:

M_p: See Table D6.1-2, Case IM_p: $P_w/(2*D)*[Y(\bar{b})^2 + (D-Y(\bar{b}))^2] + [P_{rt}*d_{rt} + P_{rb}*d_{rb} + P_t*d_t + P_c*d_c]$ Y($\bar{b}$): $(D/2)*[(P_c - P_t - P_{rt} - P_{rb})/P_w + 1]$ P_c: F_{yc}*b_c*t_c: 972 kipP_t: F_{yt}*b_t*t_t: 972 kipP_{rt}: 0 no concrete reinforcing steelP_{rb}: 0 no concrete reinforcing steelP_w: F_{yw}*D*t_w*2: 1083.375 kip

This is multiplied by 2 due to two webs

Y($\bar{b}$): 20.0625d_{rt}: 0 no concrete reinforcing steeld_{rb}: 0 no concrete reinforcing steeld_t: Y($\bar{b}$)+t_t/2: 20.4375 ind_c: D-Y($\bar{b}$)+t_c/2: 20.4375 inM_p: 50598.11 kip-in

Hybrid factor:

R_h: See Article 6.10.1.10.1R_h: 1

Yield Moment

M_y: Smaller of M_{yc} and M_{yt}, See Article D6.2.M_{yc}: F_{yc}*S_{xc}: 46003 kip-inM_{yt}: F_{yt}*S_{xt}: 46003 kip-inM_y: 46002.96 kip-in
 $\lambda_{md}(pw(D_{cp}))$: smaller of
 $((E/F_y)^{.5})/(0.54*(M_p/(R_h*M_y)) - 0.09)^{.2}$ 111.8
 $\lambda_{md}(rw)*(D_{cp}/D_c)$ 161.8
 $\lambda_{md}(pw(D_{cp}))$: 111.8

Web Compact?

2*D_{cp}/t_w: 107.0 $\lambda_{md}(pw(D_{cp}))$: 111.8Web is Compact, R_{pc}=M_p/M_{yc}

Web Plastification Factor - Comp:

R_{pc}: M_p/M_{yc}: 1.100 Use if Web is Compact

Article A6.2.2 - Noncompact Web Sections

Verify the webs are non-compact and not slender.

If $\lambda_{md}(w) < \lambda_{md}(rw)$, then noncompact.

Slenderness ratio for web:

 $\lambda_{md}(w)$: $2*D/t_w$: 107.0026567

Limiting slenderness ratio for noncompact web:

 $\lambda_{md}(rw)$: $5.7*(E/F_y)^{.5}$: 161.8

Noncompact vs Slender webs?

Noncompact, keep going

Web Plastification Factor - Comp:

R_{pc}: smaller of $[1-(1-(R_h*M_{yc}/M_p))*(\lambda_{md}(w)-\lambda_{md}(pw(D_{cp})))/(\lambda_{md}(rw)-\lambda_{md}(pw(D_{cp})))]*(M_p/M_{yc})$
M_p/M_{yc}

Limiting slenderness ratio for a compact web:

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$\lambda_{pd}(\rho_w D_c)$:	smaller of	$\lambda_{pd}(\rho_w D_c) * (D_c / D_p)$	
$\lambda_{pd}(\rho_w D_p) * (D_c / D_p)$		$\lambda_{pd}(\rho_w)$	
$\lambda_{pd}(\rho_w D_p) * (D_c / D_p)$		111.8	
$\lambda_{pd}(\rho_w D_c)$:		111.8	
$[1 - (R_h * M_y / M_p)] * ((\lambda_{pd}(w) - \lambda_{pd}(\rho_w D_c)) / (\lambda_{pd}(\rho_w) - \lambda_{pd}(\rho_w D_c))) * (M_p / M_y)$			1.109
M_p / M_y			1.100
R_{pc} :		1.100	Use if Web is Compact

Web Plastification Factor Comp: R_{pc} (FINAL): 1.100

Nominal Flexural Resistance - comp: M_{nc} : 31589 kip-in Per Article A6.3.2

Article A6.3.3 - Lateral Torsional Buckling Resistance:

If $L_b \leq L_p$, then $M_{nc} = R_{pc} * M_y$

$L_b \leq L_p$, therefore $M_{nc} = R_{pc} * M_y$ (Same as A6.3.2)

M_{nc} : 50598 kip-in Per Article A6.3.3

Nominal Flexural Resistance - Comp: M_{nc} : 31589 kip-in

A6.4 - Flexural Resistance Based on Tension Flange Yielding

Nominal Flexural Resistance - tension: M_{nt} : $R_{pt} * M_y$

Web Plastification Factor - Ten: R_{pt} : See Article A6.2.1 or Article A6.2.2 as applicable.

Article A6.2.1 - Compact Web Sections

R_{pt} : M_p / M_y : 1.100 Use if Web is Compact

Article A6.2.2 - Noncompact Web Sections			
R_{pt} :	smaller of	$[1 - (R_h * M_y / M_p)] * ((\lambda_{pd}(w) - \lambda_{pd}(\rho_w D_c)) / (\lambda_{pd}(\rho_w) - \lambda_{pd}(\rho_w D_c))) * (M_p / M_y)$	
		M_p / M_y	
$[1 - (R_h * M_y / M_p)] * ((\lambda_{pd}(w) - \lambda_{pd}(\rho_w D_c)) / (\lambda_{pd}(\rho_w) - \lambda_{pd}(\rho_w D_c))) * (M_p / M_y)$			1.109
M_p / M_y			1.100
R_{pt} :		1.100	Use if Web is Noncompact

R_{pt} (FINAL): 1.100

Nominal Flexural Resistance - Ten: M_{nt} : 50598 kip-in

Project: MnDOT Special Structures - 69801J - Bridge 3A Pier 4
 Date: 22-Feb-10
 RisaSection Name: BR3A-P4-h

Project Number: 90147
 Eng: JDF
 Checked By:

55/2/10

Spreadsheet has been created for use with Box Steel Beam Caps Only.
 For sections with compact, non-compact, or slender flanges.
 For sections with compact or non-compact webs.

Yield Strengths:	Fy:	36 ksi	Fyt:	36 ksi	Fyw:	36 ksi
Modulus of Elasticity:	E:	29000 ksi				
Compression Flange:	bfc:	36 in	tf:	0.75 in		
Tension Flange:	btf:	36 in	tt:	0.75 in		
Webs:	D:	45.875 in	tw:	1 in		
Clear Space between webs:		30 in				
Unbraced Length:	Lb:	108 in				
Neutral Axis:	Y-bar (Comp)	23.688 in	Y bar (Ten)	23.688 in	X-bar	18 in
Moment of Inertia:	Ixx	45440 in^4	Iyy	27880 in^4	Sy	1549.03 in^3
Section Modulus:	Sx (Comp)	1918.35 in^3	Sx (Ten)	1918.35 in^3		
Radius:	rx	17.657 in	ry	13.831 in		
Plastic Modulus:	Zx	2311.13 in^3	Zy	1908.13 in^3		
Torsional Constant:	J	40.377 in^4				

Based on AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition, 2007, With 2008 & 2009 Interim Revisions
 Article 6.10 - I-Section Flexural Members
 Article 6.10.6 - Strength Limit State
 Article 6.10.6.2 - Flexure
 Article 6.10.6.2.3 - Composite Sections in Negative Flexure and Noncomposite Sections

If the following conditions are met, proportion the section according to the provisions for compact or noncompact web sections specified in Appendix A. Otherwise, the section shall be proportioned according to provisions specified in Article 6.10.8.

Depth of Web in Comp:	Dc:	22.938 in
Moment of Inertia Comp Flange:	Iyc:	2916.0 in^4
Moment of Inertia Tens Flange:	Iyt:	2916.0 in^4

Yield Strength Limit:	Max Fy:	36 ksi	Limit Fy:	70 ksi	OK - Keep Going
Web Slenderness Limit (slender):	2*Dc/tw:	45.876	5.7*(E/Fyc)^.5:	161.8 ksi	OK - Keep Going
Flange Ratio:	Iyc/Iyt:	1	Limit:	0.3	OK - Keep Going

Appendix A6: Flexural Resistance of Straight Composite I-Sections in Negative Flexure and Straight Non-composite I-sections with Compact or Noncompact Webs
 Article A6.1 - General - Same as Article 6.10.6.2.3 above.
 Article A6.1.1 - Sections with Discretely Braced Compression Flanges

At the limit state the following requirement shall be satisfied: $M_u + (1/3) * f_l * S_{xc} \leq \phi(f) * M_{nc}$

Bending Moment - Major Axis:	Mu:	Varies, see Risa 3D
Flange Lateral Bending Stress:	fl:	See Article 6.10.1.6

Flange lateral bending stress, fl, may be determined directly from first-order elastic analysis in discretely braced compression flanges for which: $b \leq 1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{.5}$

Limiting Unbraced Length:	Lp:	See Article 6.10.8.2.3
	Lp:	1.0 * rt * (E/Fyc)^.5
Effective Radius of Gyration:	rt:	$b_{fc} / (12 * (1 + (1/3) * (D_c * t_w / (b_{fc} * t_{fc}))))^{.5}$
	rt:	9.2 in
	Lp:	260.4 in

Moment Gradient Modifier:	Cb:	See Article 6.10.8.2.3 or Article A6.3.3, as applicable
	Cb:	1 Since $M_{mid} / M_2 > 1$ at most situations. May be conservative at some locations.

Web Load-shedding Factor:	Rb:	See Article 6.10.1.10.2	1.0 if $2 * D_c / t_w \leq \lambda_{md} (rw)$
Web Slenderness Limit (noncompact):	lambda (rw):	5.7 * (E/Fyc)^.5	161.8
	2*Dc/tw:	45.876	
	Rb:	1	

Major Axis Bending to Yield Moment:	Mu/Myc:	1 Assume 1.0. Conservative.
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Unbraced Limit for fl:	Lb:	108 in	$1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{.5}$	312.5 in	OK - Keep Going, First-order elastic analysis
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Flange Lateral Bending Stress:	fl:	Muy/Sy	First-order elastic analysis
Factored Weak Axis Bending Moment:	Muy:	See Risa	

Resistance Factor for Flexure:	phi(f):	1 As specified in Article 6.5.4.2
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Nominal Flexural Resistance: Mnc: See Article A6.3
 Nominal Flexural Resistance based on compression flange, Mnc, shall be taken as the smaller of the local buckling resistance determined as specified in Article A6.3.2, and the lateral torsional buckling resistance determined as specified in Article A6.3.3.

Article A6.3.2 - Local Buckling Resistance:
 Determine if the compression flange is compact:

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Limiting Slenderness Ratio for Compact Flange:

Use two ratios, one for the flange between the webs, and the other for the flange overhang. See AISC Table B4.1.

Case 12: Uniform compression in flanges of rectangular box and hollow structural sections of uniform thickness subject to bending or compression.

λ_{mf}	b/t	40.00	Clear space between webs/t _c
λ_{mpf}	$1.12 \cdot (E/F_y)^{0.5}$	31.79	
λ_{mrf}	$1.40 \cdot (E/F_y)^{0.5}$	39.74	

Case 12: Slender Flange

Case 2: Flexure in flanges of doubly and singly symmetric I-shaped built-up sections.

λ_{mf}	b/t	3.33	Flange overhang measured from mid-web/t _{fc}
λ_{mpf}	$0.38 \cdot (E/F_y)^{0.5}$	10.79	
λ_{mrf}	$0.95 \cdot (E \cdot k_c / F_y)^{0.5}$	24.77	
k_c	$4 / (D/t_w)^{0.5}$	0.59	but $0.35 \leq k_c \leq 0.76$
k_c	0.59		
F_{yr}	smaller of 3 items below:		
	$0.7 \cdot F_{yc}$	25.2	ksi
	$R_h \cdot F_{yt} \cdot S_{xt} / S_{xc}$	36.0	ksi
	F_{yw}	36.0	ksi
	but not less than:		
	$0.5 \cdot F_{yc}$	18.0	ksi

 F_{yr} : 25.2 ksiCase 2: Compact Flange If Case 2 Flange is Noncompact or Slender, then check λ_{md} s used.

Slender Flange Worse condition of Case 12 and Case 2

Compression Flange:

Nominal Flexural Resistance:	M_{nc}	$[1 - (1 - (F_{yr} \cdot S_{xc}) / (R_{pc} \cdot M_{yc})) \cdot (\lambda_{mf} - \lambda_{mpf}) / (\lambda_{mrf} - \lambda_{mpf})] \cdot R_{pc} \cdot M_{yc}$	Equation A6.3.2-1 or A6.3.2-2
Web Plastification Factor - Comp:	R_{pc}	See Article A6.2.1 or A6.2.2, as applicable	

Article A6.2.1 - Compact Web Sections:

Determine if the web is compact:

Depth of Web in Comp at Plastic Mom:

Compact if $2 \cdot D_{cp} / t_w \leq \lambda_{md}$ (pw(Dcp)) D_{cp} : See Article D6.3.2For non composite sections where: $F_{yw} \cdot A_w \geq |F_{yc} \cdot A_c - F_{yt} \cdot A_t|$, $D_{cp} = D / (2 \cdot A_w \cdot F_{yw}) [F_{yt} \cdot A_t + F_{yw} \cdot A_w - F_{yc} \cdot A_c]$, otherwise $D_{cp} = D$. $F_{yw} \cdot A_w$: 3303 kip | $F_{yc} \cdot A_c - F_{yt} \cdot A_t$: 0 kipUse $2 \cdot D \cdot t_w$ for A_w due to two webs D_{cp} : 22.9 in

Limiting Slenderness Ratio for Compact Web:

 λ_{md} (pw(Dcp)): $((E/F_y)^{0.5}) / (0.54 \cdot (M_p / (R_h \cdot M_y)) - 0.09)^{0.5} \leq \lambda_{md}(rw) \cdot (D_{cp} / D_c)$

Plastic Moment

 M_p : See Article D6.1

Article D6.1 - Plastic Moment:

 M_p : See Table D6.1-2, Case I M_p : $P_w / (2 \cdot D) \cdot [Y(\bar{b})^2 + (D - Y(\bar{b}))^2] + [P_{rt} \cdot d_{rt} + P_{rb} \cdot d_{rb} + P_t \cdot d_t + P_c \cdot d_c]$ $Y(\bar{b})$: $(D/2) \cdot [(P_c - P_t - P_{rt} - P_{rb}) / P_w + 1]$ P_c : $F_{yc} \cdot b_c \cdot t_c$: 972 kip P_t : $F_{yt} \cdot b_t \cdot t_t$: 972 kip P_{rt} : 0 no concrete reinforcing steel P_{rb} : 0 no concrete reinforcing steel P_w : $F_{yw} \cdot D \cdot t_w \cdot 2$: 3303 kip

This is multiplied by 2 due to two webs

 $Y(\bar{b})$: 22.9375 d_{rt} : 0 no concrete reinforcing steel d_{rb} : 0 no concrete reinforcing steel d_t : $Y(\bar{b}) + t_t / 2$: 23.3125 in d_c : $D - Y(\bar{b}) + t_c / 2$: 23.3125 in M_p : 83200.78 kip-in

Hybrid factor:

 R_h : See Article 6.10.1.10.1 R_h : 1

Yield Moment

 M_y : Smaller of M_{yc} and M_{yt} , See Article D6.2. M_{yc} : $F_{yc} \cdot S_{xc}$: 69061 kip-in M_{yt} : $F_{yt} \cdot S_{xt}$: 69061 kip-in M_y : 69060.6 kip-in λ_{md} (pw(Dcp)): smaller of $((E/F_y)^{0.5}) / (0.54 \cdot (M_p / (R_h \cdot M_y)) - 0.09)^{0.5}$: 90.3 $\lambda_{md}(rw) \cdot (D_{cp} / D_c)$: 161.8 λ_{md} (pw(Dcp)): 90.3

Web Compact?

 $2 \cdot D_{cp} / t_w$: 45.9 λ_{md} (pw(Dcp)): 90.3Web is Compact, $R_{pc} = M_p / M_{yc}$

Web Plastification Factor - Comp:

 R_{pc} : M_p / M_{yc} : 1.205 Use if Web is Compact

Article A6.2.2 - Noncompact Web Sections

Verify the webs are non-compact and not slender.

If $\lambda_{md}(w) < \lambda_{md}(rw)$, then noncompact.Slenderness ratio for web: $\lambda_{md}(w)$: $2 \cdot D_{cp} / t_w$: 45.9375Limiting Slenderness ratio for noncompact web: $\lambda_{md}(rw)$: $5.7 \cdot (E/F_y)^{0.5}$: 161.8

Noncompact vs Slender webs? Noncompact, keep going

Web Plastification Factor - Comp: R_{pc} : smaller of $[1 - (1 - (R_h \cdot M_{yc} / M_p)) \cdot (\lambda_{md}(w) - \lambda_{md}(pw(D_{cp}))) / (\lambda_{md}(w) - \lambda_{md}(pw(D_{cp})))] \cdot M_p / M_{yc}$

Limiting Slenderness ratio for a compact web:

$\lambda_{pw(Dc)}$:	smaller of	$\lambda_{pw(Dcp)} * (Dc/Dcp)$	
$\lambda_{pw(Dcp)} * (Dc/Dcp)$		λ_{pw}	
$\lambda_{pw(Dc)}$:		90.3	
		90.3	
$[1 - (R_h * Myc / Mp)] * ((\lambda_{da(w)} - \lambda_{da(pw(Dc)})) / (\lambda_{da(rw)} - \lambda_{da(pw(Dc))})) * (Mp / Myc)$			1.332
Mp / Myc			1.205
Rpc:	1.205	Use if Web is Compact	

Web Plastification Factor Comp: Rpt (FINAL): 1.205

Nominal Flexural Resistance - comp: Mnc: 47181 kip-in Per Article A6.3.2

Article A6.3.3 - Lateral Torsional Buckling Resistance:

If $L_b \leq L_p$, then $Mnc = Rpc * Myc$

$L_b \leq L_p$, therefore $Mnc = Rpc * Myc$ (Same as A6.3.2)

Mnc: 83201 kip-in Per Article A6.3.3

Nominal Flexural Resistance - Comp: Mnc: 47181 kip-in

A6.4 - Flexural Resistance Based on Tension Flange Yielding

Nominal Flexural Resistance - tension: Mnt: Rpt * Myt

Web Plastification Factor - Ten: Rpt: See Article A6.2.1 or Article A6.2.2 as applicable.

Article A6.2.1 - Compact Web Sections

Rpt: Mp/Myt: 1.205 Use if Web is Compact

Article A6.2.2 - Noncompact Web Sections			
Rpt:	smaller of	$[1 - (R_h * Myt / Mp)] * ((\lambda_{da(w)} - \lambda_{da(pw(Dc)})) / (\lambda_{da(rw)} - \lambda_{da(pw(Dc))})) * (Mp / Myt)$	
		Mp / Myt	
$[1 - (R_h * Myt / Mp)] * ((\lambda_{da(w)} - \lambda_{da(pw(Dc)})) / (\lambda_{da(rw)} - \lambda_{da(pw(Dc))})) * (Mp / Myt)$			1.332
Mp / Myt			1.205
Rpt:	1.205	Use if Web is Compact	

Rpt (FINAL): 1.205

Nominal Flexural Resistance - Ten: Mnt: 83201 kip-in

Project: MnDOT Special Structures - 69801J - Bridge 3A Pier 4
 Date: 22-Feb-10
 RisaSection Name: BR3A-P4-i

Project Number: 90147
 Eng: JDF
 Checked By:

5/5/21/10

Spreadsheet has been created for use with Box Steel Beam Caps Only.
 For sections with compact, non-compact, or slender flanges.
 For sections with compact or non-compact webs.

Yield Strengths:	F _{yc} :	36 ksi	F _{yt} :	36 ksi	F _{yw} :	36 ksi
Modulus of Elasticity:	E:	29000 ksi				
Compression Flange:	b _{fc} :	36 in	t _{fc} :	0.75 in		
Tension Flange:	b _{tc} :	36 in	t _{tc} :	0.75 in		
Webs:	D:	44.938 in	t _w :	0.375 in		
Clear Space between webs:		30 in				

Unbraced Length: L_b: 108 in

Neutral Axis:	Y-bar (Comp)	23.219 in	Y bar (Ten)	23.219 in	X-bar	18 in
Moment of Inertia:	I _{xx}	33850 in ⁴	I _{yy}	13610 in ⁴		
Section Modulus:	S _x (Comp)	1458.02 in ³	S _x (Ten)	1458.02 in ³	S _y	755.91 in ³
Radius:	r _x	19.647 in	r _y	12.456 in		
Plastic Modulus:	Z _x	1612.2 in ³	Z _y	997.87 in ³		
Torsional Constant:	J	11.625 in ⁴				

Based on AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition, 2007, With 2008 & 2009 Interim Revisions
 Article 6.10 - I-Section Flexural Members
 Article 6.10.6 - Strength Limit State
 Article 6.10.6.2 - Flexure
 Article 6.10.6.2.3 - Composite Sections in Negative Flexure and Noncomposite Sections

If the following conditions are met, proportion the section according to the provisions for compact or noncompact web sections specified in Appendix A. Otherwise, the section shall be proportioned according to provisions specified in Article 6.10.8.

Depth of Web in Comp:	D _c :	22.469 in
Moment of Inertia Comp Flange:	I _{yc} :	2916.0 in ⁴
Moment of Inertia Tens Flange:	I _{yt} :	2916.0 in ⁴

Yield Strength Limit:	Max F _y :	36 ksi	Limit F _y :	70 ksi	OK - Keep Going
Web Slenderness Limit (slender):	2*D _c /t _w :	119.8347	5.7*(E/F _{yc}) ^{0.5} :	161.8 ksi	OK - Keep Going
Flange Ratio:	I _{yc} /I _{yt} :	1	Limit:	0.3	OK - Keep Going

Appendix A6: Flexural Resistance of Straight Composite I-Sections in Negative Flexure and Straight Non-composite I-sections with Compact or Noncompact Webs
 Article A6.1 - General - Same as Article 6.10.6.2.3 above.
 Article A6.1.1 - Sections with Discretely Braced Compression Flanges

At the limit state the following requirement shall be satisfied: $M_u + (1/3) * f_l * S_{xc} \leq \phi(f) * M_{nc}$

Bending Moment - Major Axis:	M _u :	Varies, see Risa 3D
Flange Lateral Bending Stress:	f _l :	See Article 6.10.1.6

Flange lateral bending stress, f_l, may be determined directly from first-order elastic analysis in discretely braced compression flanges for which: $b \leq 1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{0.5}$

Limiting Unbraced Length:	L _p :	See Article 6.10.8.2.3
	L _p :	1.0 * r _x * (E/F _{yc}) ^{0.5}
Effective Radius of Gyration:	r _c :	$b_{fc} / (12 * (1 + (1/3) * (D_c * t_w / (b_{tc} * t_{tc}))))^{0.5}$
	r _c :	9.9 in
	L _p :	280.7 in

Moment Gradient Modifier:	C _b :	See Article 6.10.8.2.3 or Article A6.3.3, as applicable
	C _b :	1 Since M _{mid} /M ₂ > 1 at most situations. May be conservative at some locations.

Web Load-shedding Factor:	R _b :	See Article 6.10.1.10.2	1.0 if 2*D _c /t _w ≤ λ _{da} (rw)
Web Slenderness Limit (noncompact):	λ _{da} (rw):	5.7*(E/F _{yc}) ^{0.5}	161.8
	2*D _c /t _w :	119.8347	
	R _b :	1	

Major Axis Bending to Yield Moment:	M _u /M _{yc} :	1 Assume 1.0. Conservative.
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Unbraced Limit for f _l :	L _b :	108 in	1.2 * L _p * (C _b * R _b / (M _u / M _{yc})) ^{0.5}	336.9 in	OK - Keep Going, First-order elastic analysis
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Flange Lateral Bending Stress:	f _l :	M _{uy} /S _y First-order elastic analysis
Factored Weak Axis Bending Moment:	M _{uy} :	See Risa

Resistance Factor for Flexure:	φ(f):	1 As specified in Article 6.5.4.2
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Nominal Flexural Resistance: M_{nc}: See Article A6.3
 Nominal Flexural Resistance based on compression flange, M_{nc}, shall be taken as the smaller of the local buckling resistance determined as specified in Article A6.3.2, and the lateral torsional buckling resistance determined as specified in Article A6.3.3.

Article A6.3.2 - Local Buckling Resistance:
 Determine if the compression flange is compact:

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Limiting Slenderness Ratio for Compact Flange: Use two ratios, one for the flange between the webs, and the other for the flange overhang. See AISC Table B4.1.

Case 12: Uniform compression in flanges of rectangular box and hollow structural sections of uniform thickness subject to bending or compression.

λ_{mf} b/t: 40.00 Clear space between webs/t_w
 λ_{mpf} $1.12 \cdot (E/F_y)^{0.5}$: 31.79
 λ_{mrf} $1.40 \cdot (E/F_y)^{0.5}$: 39.74

Case 12: Slender Flange

Case 2: Flexure in flanges of doubly and singly symmetric I-shaped built-up sections.

λ_{mf} b/t: 3.75 Flange overhang measured from mid-web/t_w
 λ_{mpf} $0.38 \cdot (E/F_y)^{0.5}$: 10.79
 λ_{mrf} $0.95 \cdot (E \cdot k_c / F_y)^{0.5}$: 19.48
 k_c $4 / (D/t_w)^{0.5}$: 0.37 but $0.35 \leq k_c \leq 0.76$

k_c : 0.37
 F_y : smaller of 3 items below:
 $0.7 \cdot F_y$: 25.2 ksi
 $R_h \cdot F_y \cdot S_x / S_x$: 36.0 ksi
 F_y : 36.0 ksi
 but not less than:
 $0.5 \cdot F_y$: 18.0 ksi

F_y : 25.2 ksi

Case 2: Compact Flange If Case 2 Flange is Noncompact or Slender, then check λ mdas used.

Slender Flange Worse condition of Case 12 and Case 2

Compression Flange:

Nominal Flexural Resistance: M_n : $[1 - (1 - (F_y \cdot S_x) / (R_p \cdot M_y)) \cdot (\lambda_{mf} - \lambda_{mpf}) / (\lambda_{mrf} - \lambda_{mpf})] \cdot R_p \cdot M_y$ Equation A6.3.2-1 or A6.3.2-2
 Web Plastification Factor - Comp: R_p : See Article A6.2.1 or A6.2.2, as applicable

Article A6.2.1 - Compact Web Sections:

Determine if the web is compact:

Depth of Web in Comp at Plastic Mom:

Compact if $2 \cdot D_{cp} / t_w \leq \lambda_{mda}(pw(D_{cp}))$

D_{cp} : See Article D6.3.2

For non composite sections where: $F_y \cdot A_w \geq |F_y \cdot A_c - F_y \cdot A_t|$, $D_{cp} = D / (2 \cdot A_w \cdot F_y) [F_y \cdot A_t + F_y \cdot A_w - F_y \cdot A_c]$, otherwise $D_{cp} = D$.

$F_y \cdot A_w$: 1213.326 kip | $F_y \cdot A_c - F_y \cdot A_t$: 0 kip Use $2 \cdot D \cdot t_w$ for A_w due to two webs

D_{cp} : 22.5 in

Limiting Slenderness Ratio for Compact Web:

$\lambda_{mda}(pw(D_{cp}))$: $((E/F_y)^{0.5}) / (0.54 \cdot (M_p / (R_h \cdot M_y)) - 0.09)^{0.2} \leq \lambda_{mda}(rw) \cdot (D_{cp} / D_c)$

Plastic Moment

M_p : See Article D6.1

Article D6.1 - Plastic Moment:

M_p : See Table D6.1-2, Case I

M_p : $P_w / (2 \cdot D) \cdot [Y(\bar{y})^2 + (D - Y(\bar{y}))^2] + [P_r \cdot d_r + P_r \cdot d_b + P_t \cdot d_t + P_c \cdot d_c]$

$Y(\bar{y})$: $(D/2) \cdot [(P_c - P_t - P_r \cdot P_b) / P_w + 1]$

P_c : $F_y \cdot b_c \cdot t_c$: 972 kip

P_t : $F_y \cdot b_t \cdot t_t$: 972 kip

P_r : 0 no concrete reinforcing steel

P_b : 0 no concrete reinforcing steel

P_w : $F_y \cdot D \cdot t_w \cdot 2$: 1213.326 kip This is multiplied by 2 due to two webs

$Y(\bar{y})$: 22.469

d_r : 0 no concrete reinforcing steel

d_b : 0 no concrete reinforcing steel

d_t : $Y(\bar{y}) + t_t / 2$: 22.844 in

d_c : $D - Y(\bar{y}) + t_c / 2$: 22.844 in

M_p : 58039.85 kip-in

Hybrid factor:

R_h : See Article 6.10.1.10.1

R_h : 1

Yield Moment

M_y : Smaller of M_{yc} and M_{yt} , See Article D6.2.

M_{yc} : $F_y \cdot S_x$: 52489 kip-in

M_{yt} : $F_y \cdot S_t$: 52489 kip-in

M_y : 52488.72 kip-in

$\lambda_{mda}(pw(D_{cp}))$: smaller of

$((E/F_y)^{0.5}) / (0.54 \cdot (M_p / (R_h \cdot M_y)) - 0.09)^{0.2}$: 110.4

$\lambda_{mda}(rw) \cdot (D_{cp} / D_c)$: 161.8

$\lambda_{mda}(pw(D_{cp}))$: 110.4

Web Compact?

$2 \cdot D_{cp} / t_w$: 119.8

$\lambda_{mda}(pw(D_{cp}))$: 110.4

Web is not compact, See Article A6.2.2

Web Plastification Factor - Comp: R_p : M_p / M_y : 1.106

Article A6.2.2 - Noncompact Web Sections

Verify the webs are non-compact and not slender.

If $\lambda_{mda}(w) < \lambda_{mda}(rw)$, then noncompact.

Slenderness ratio for web: $\lambda_{mda}(w)$: $2 \cdot D_c / t_w$: 119.8346667

Limiting Slenderness ratio for noncompact web: $\lambda_{mda}(rw)$: $5.7 \cdot (E/F_y)^{0.5}$: 161.8

Noncompact vs Slender webs?

Noncompact, keep going

Web Plastification Factor - Comp:

R_p : smaller of $[1 - (R_h \cdot M_y / M_p)] \cdot ((\lambda_{mda}(w) - \lambda_{mda}(pw(D_c))) / (\lambda_{mda}(rw) - \lambda_{mda}(pw(D_c)))) \cdot (M_p / M_y)$
 M_p / M_y

Limiting Slenderness ratio for a compact web:

$\lambda_{pw}(Dc)$: smaller of $\lambda_{pw}(Dcp) \cdot (Dc/Dcp)$
 λ_{rw}

$\lambda_{pw}(Dcp) \cdot (Dc/Dcp)$ 110.4
 $\lambda_{pw}(Dc)$: 110.4

$[1 - (1 - (R_h \cdot M_{yc}/M_p)) \cdot ((\lambda_{w} - \lambda_{pw}(Dc)) / (\lambda_{rw} - \lambda_{pw}(Dc)))] \cdot (M_p/M_{yc})$ 1.086
Mp/Myc 1.106

Rpc: 1.086 Use if Web is Noncompact

Web Plastification Factor Comp: Rpc (FINAL): 1.086

Nominal Flexural Resistance - comp: Mnc: 36067 kip-in Per Article A6.3.2

Article A6.3.3 - Lateral Torsional Buckling Resistance:

If $L_b \leq L_p$, then $M_{nc} = R_{pc} \cdot M_{yc}$
 $L_b \leq L_p$, therefore $M_{nc} = R_{pc} \cdot M_{yc}$ (Same as A6.3.2)
Mnc: 57018 kip-in Per Article A6.3.3

Nominal Flexural Resistance - Comp: Mnc: 36067 kip-in

A6.4 - Flexural Resistance Based on Tension Flange Yielding

Nominal Flexural Resistance - tension: Mnt: Rpt * Myt

Web Plastification Factor - Ten: Rpt: See Article A6.2.1 or Article A6.2.2 as applicable.

Article A6.2.1 - Compact Web Sections

Rpt: Mp/Myt: 1.106 Use if Web is Compact

Article A6.2.2 - Noncompact Web Sections

Rpt: smaller of $[1 - (1 - (R_h \cdot M_{yt}/M_p)) \cdot ((\lambda_{w} - \lambda_{pw}(Dc)) / (\lambda_{rw} - \lambda_{pw}(Dc)))] \cdot (M_p/M_{yt})$
Mp/Myt

$[1 - (1 - (R_h \cdot M_{yt}/M_p)) \cdot ((\lambda_{w} - \lambda_{pw}(Dc)) / (\lambda_{rw} - \lambda_{pw}(Dc)))] \cdot (M_p/M_{yt})$ 1.086
Mp/Myt 1.106

Rpt: 1.086 Use if Web is Noncompact

Rpt (FINAL): 1.086

Nominal Flexural Resistance - Ten: Mnt: 57018 kip-in

Project: MnDOT Special Structures - 69801J - Bridge 3A Pier 4
 Date: 22-Feb-10
 RisaSection Name: BR3A-P4-j

Project Number: 90147
 Eng: JDF
 Checked By:

5/5/21/10

Spreadsheet has been created for use with Box Steel Beam Caps Only.
 For sections with compact, non-compact, or slender flanges.
 For sections with compact or non-compact webs.

Yield Strengths:	F _{yc} :	36 ksi	F _{yt} :	36 ksi	F _{yw} :	36 ksi
Modulus of Elasticity:	E:	29000 ksi				
Compression Flange:	b _{fc} :	42 in	t _{fc} :	3 in		
Tension Flange:	b _{tc} :	36 in	t _{ft} :	0.75 in		
Webs:	D:	43.625 in	tw:	1 in		
Clear Space between webs:		30 in				

Unbraced Length: L_b: 49.2 in

Neutral Axis:	Y-bar (Comp)	15.083 in	Y bar (Ten)	32.294 in	X-bar	21 in
Moment of Intertia:	I _{xx}	72950 in ⁴	I _{yy}	42410 in ⁴		
Section Modulus:	S _x (Comp)	4837.23 in ³	S _x (Ten)	2258.85 in ³	S _y	2019.38 in ³
Radius:	r _x	17.425 in	r _y	13.286 in		
Plastic Modulus:	Z _x	3279.32 in ³	Z _y	2918.38 in ³		
Torsional Constant:	J	396.09 in ⁴				

Based on AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition, 2007, With 2008 & 2009 Interim Revisions
 Article 6.10 - I-Section Flexural Members
 Article 6.10.6 - Strength Limit State
 Article 6.10.6.2 - Flexure
 Article 6.10.6.2.3 - Composite Sections in Negative Flexure and Noncomposite Sections

If the following conditions are met, proportion the section according to the provisions for compact or noncompact web sections specified in Appendix A. Otherwise, the section shall be proportioned according to provisions specified in Article 6.10.8.

Depth of Web in Comp:	D _c :	12.081 in
Moment of Inertia Comp Flange:	I _{yc} :	18522.0 in ⁴
Moment of Inertia Tens Flange:	I _{yt} :	2916.0 in ⁴

Yield Strength Limit:	Max F _y :	36 ksi	Limit F _y :	70 ksi	OK - Keep Going
Web Slenderness Limit (slender):	2*D _c /tw:	24.162	5.7*(E/F _{yc}) ^{0.5} :	161.8 ksi	OK - Keep Going
Flange Ratio:	I _{yc} /I _{yt} :	6.351852	Limit:	0.3	OK - Keep Going

Appendix A6: Flexural Resistance of Straight Composite I-Sections in Negative Flexure and Straight Non-composite I-sections with Compact or Noncompact Webs
 Article A6.1 - General - Same as Article 6.10.6.2.3 above.
 Article A6.1.1 - Sections with Discretely Braced Compression Flanges

At the limit state the following requirement shall be satisfied: $M_u + (1/3) * f_l * S_{xc} \leq \phi(f) * M_{nc}$

Bending Moment - Major Axis:	M _u :	Varies, see Risa 3D
Flange Lateral Bending Stress:	f _l :	See Article 6.10.1.6

Flange lateral bending stress, f_l, may be determined directly from first-order elastic analysis in discretely braced compression flanges for which: $b \leq 1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{0.5}$

Limiting Unbraced Length:	L _p :	See Article 6.10.8.2.3
	L _p :	1.0 * r _t * (E/F _{yc}) ^{0.5}
Effective Radius of Gyration:	r _t :	b _{fc} / (12 * (1 + (1/3) * (D _c * tw / (b _{fc} * t _{fc})))) ^{0.5}
	r _t :	11.9 in
	L _p :	338.7 in

Moment Gradient Modifier:	C _b :	See Article 6.10.8.2.3 or Article A6.3.3, as applicable
	C _b :	1 Since M _{mid} /M ₂ > 1 at most situations. May be conservative at some locations.

Web Load-shedding Factor:	R _b :	See Article 6.10.1.10.2 1.0 if 2*D _c /tw ≤ λ _{md} (rw)
Web Slenderness Limit (noncompact):	λ _{md} (rw):	5.7*(E/F _{yc}) ^{0.5} 161.8
	2*D _c /tw:	24.162
	R _b :	1

Major Axis Bending to Yield Moment:	M _u /M _{yc} :	1 Assume 1.0. Conservative.
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Unbraced Limit for f _l :	L _b :	49.2 in	1.2 * L _p * (C _b * R _b / (M _u / M _{yc})) ^{0.5}	406.5 in	OK - Keep Going, First-order elastic analysis
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Flange Lateral Bending Stress:	f _l :	M _{uy} /S _y First-order elastic analysis
Factored Weak Axis Bending Moment:	M _{uy} :	See Risa

Resistance Factor for Flexure:	φ(f):	1 As specified in Article 6.5.4.2
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Nominal Flexural Resistance:	M _{nc} :	See Article A6.3
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Nominal Flexural Resistance based on compression flange, M_{nc}, shall be taken as the smaller of the local buckling resistance determined as specified in Article A6.3.2, and the lateral torsional buckling resistance determined as specified in Article A6.3.3.

Article A6.3.2 - Local Buckling Resistance:
 Determine if the compression flange is compact:

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Limiting Slenderness Ratio for Compact Flange: Use two ratios, one for the flange between the webs, and the other for the flange overhang. See AISC Table B4.1.

Case 12: Uniform compression in flanges of rectangular box and hollow structural sections of uniform thickness subject to bending or

compression.

lamda(f)	b/t:	10.00	Clear space between webs/t _{fc}
lamda(pf)	$1.12 \cdot (E/F_y)^{0.5}$:	31.79	
lamda(rf)	$1.40 \cdot (E/F_y)^{0.5}$:	39.74	

Case 12: Compact Flange

Case 2: Flexure in flanges of doubly and singly symmetric I-shaped built-up sections.

lamda(f)	b/t:	1.83	Flange overhang measured from mid-web/t _{fc}
lamda(pf)	$0.38 \cdot (E/F_y)^{0.5}$:	10.79	
lamda(rf)	$0.95 \cdot (E \cdot k_c / F_y)^{0.5}$:	29.67	
k _c :	$4 / (D/t_w)^{0.5}$:	0.61	but $0.35 \leq k_c \leq 0.76$
k _c :	0.61		

F_{yr}: smaller of 3 items below:

0.7 · F _{yc} :	25.2	ksi
R _h · F _{yt} · S _{xt} / S _{xc} :	16.8	ksi
F _{yw} :	36.0	ksi
but not less than:		
0.5 · F _{yc} :	18.0	ksi

F_{yr}: 18.0 ksi

Case 2: Compact Flange If Case 2 Flange is Noncompact or Slender, then check lamdas used.

Compact Flange Worse condition of Case 12 and Case 2

Compression Flange:

Nominal Flexural Resistance:

M_{nc}: M_{nc} = R_{pc} · M_{yc}

Equation A6.3.2-1 or A6.3.2-2

Web Plastification Factor - Comp:

R_{pc}: See Article A6.2.1 or A6.2.2, as applicable

Article A6.2.1 - Compact Web Sections:

Determine if the web is compact:

Compact if $2 \cdot D_{cp} / t_w \leq \lambda_{pw}(D_{cp})$

Depth of Web in Comp at Plastic Mom:

D_{cp}: See Article D6.3.2

For non composite sections where: $F_{yw} \cdot A_w \geq |F_{yc} \cdot A_c - F_{yt} \cdot A_t|$, $D_{cp} = D / (2 \cdot A_w \cdot F_{yw}) [F_{yt} \cdot A_t + F_{yw} \cdot A_w - F_{yc} \cdot A_c]$, otherwise $D_{cp} = D$.

F_{yw} · A_w: 3141 kip | F_{yc} · A_c - F_{yt} · A_t: 3564 kip

Use $2 \cdot D \cdot t_w$ for A_w due to two webs

D_{cp}: 43.6 in

Limiting Slenderness Ratio for Compact Web:

lamda (pw(D_{cp})): $((E/F_{yc})^{0.5}) / (0.54 \cdot (M_p / (R_h \cdot M_y)) - 0.09)^{0.5} \leq \lambda_{rw}(D_{cp}/D_c)$

Plastic Moment

M_p: See Article D6.1

Article D6.1 - Plastic Moment:

M_p: See Table D6.1-2, Case I

M_p: $P_w / (2 \cdot D) \cdot [Y(\bar{y})^2 + (D - Y(\bar{y}))^2] + [P_{rt} \cdot d_{rt} + P_{rb} \cdot d_{rb} + P_{t} \cdot d_t + P_{c} \cdot d_c]$

Y($\bar{y}$): $(D/2) \cdot [(P_c - P_t - P_{rt} - P_{rb}) / P_w + 1]$

P_c: F_{yc} · b_c · t_c: 4536 kip

P_t: F_{yt} · b_t · t_t: 972 kip

P_{rt}: 0 no concrete reinforcing steel

P_{rb}: 0 no concrete reinforcing steel

P_w: F_{yw} · D · t_w · 2: 3141 kip

This is multiplied by 2 due to two webs

Y($\bar{y}$): 46.5625

d_{rt}: 0 no concrete reinforcing steel

d_{rb}: 0 no concrete reinforcing steel

d_t: Y($\bar{y}$) + t_{rt} / 2: 46.9375 in

d_c: D - Y($\bar{y}$) + t_{rc} / 2: -1.4375 in

M_p: 117463.8 kip-in

Hybrid factor:

R_h: See Article 6.10.1.10.1

R_h: 1

Yield Moment

M_y: Smaller of M_{yc} and M_{yt}, See Article D6.2.

M_{yc}: F_{yc} · S_{xc}: 174140 kip-in

M_{yt}: F_{yt} · S_{xt}: 81319 kip-in

M_y: 81318.6 kip-in

lamda (pw(D_{cp})): smaller of

$((E/F_{yc})^{0.5}) / (0.54 \cdot (M_p / (R_h \cdot M_y)) - 0.09)^{0.5}$: 59.6

lamda(rw) · (D_{cp}/D_c): 584.2

lamda (pw(D_{cp})): 59.6

Web Compact?

$2 \cdot D_{cp} / t_w$: 87.3

lamda (pw(D_{cp})): 59.6

Web is not compact, See Article A6.2.2

Web Plastification Factor - Comp: R_{pc}: M_p/M_{yc}: 0.679

Article A6.2.2 - Noncompact Web Sections

Verify the webs are non-compact and not slender.

If lamda(w) < lamda(rw), then noncompact.

Slenderness ratio for web:

lamda(w): $2 \cdot D_c / t_w$: 24.162

Limiting Slenderness ratio for noncompact web:

lamda(rw): $5.7 \cdot (E/F_{yc})^{0.5}$: 161.8

Noncompact vs Slender webs?

Noncompact, keep going

Web Plastification Factor - Comp:

R_{pc}: smaller of

$[1 - (1 - (R_h \cdot M_{yc} / M_p)) \cdot ((\lambda_{pw}(w) - \lambda_{pw}(D_c)) / (\lambda_{pw}(rw) - \lambda_{pw}(D_c)))] \cdot (M_p / M_{yc})$

Limiting Slenderness ratio for a compact web:

$\lambda(pw(Dc))$: smaller of $\lambda(pw(Dcp)) \cdot (Dc/Dcp)$
 $\lambda(pw(Dcp)) \cdot (Dc/Dcp)$ 16.5
 $\lambda(pw(Dc))$: 16.5

$[1 - (1 - (Rh \cdot Myc/Mp)) \cdot ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] \cdot (Mp/Myc)$ 0.692
 Mp/Myc 0.675

Rpc: 0.675 Use if Web is Noncompact

Web Plastification Factor Comp: Rpc (FINAL): 1.421

Nominal Flexural Resistance - comp: Mnc: 247465 kip-in Per Article A6.3.2

Article A6.3.3 - Lateral Torsional Buckling Resistance:

If $L_b \leq L_p$, then $Mnc = Rpc \cdot Myc$
 $L_b \leq L_p$, therefore $Mnc = Rpc \cdot Myc$ (Same as A6.3.2)
 Mnc: 247465 kip-in Per Article A6.3.3

Nominal Flexural Resistance - Comp: Mnc: 247465 kip-in ← Incorrect

A6.4 - Flexural Resistance Based on Tension Flange Yielding

Nominal Flexural Resistance - tension: Mnt: $Rpt \cdot Myt$
 Web Plastification Factor - Ten: Rpt: See Article A6.2.1 or Article A6.2.2 as applicable.

Article A6.2.1 - Compact Web Sections
 Rpt: Mp/Myt 1.444

Article A6.2.2 - Noncompact Web Sections
 Rpt: smaller of $[1 - (1 - (Rh \cdot Myt/Mp)) \cdot ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] \cdot (Mp/Myt)$
 Mp/Myt
 $[1 - (1 - (Rh \cdot Myt/Mp)) \cdot ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] \cdot (Mp/Myt)$ 1.421
 Mp/Myt 1.444
 Rpt: 1.421 Use if Web is Noncompact

Rpt (FINAL): 1.421

Nominal Flexural Resistance - Ten: Mnt: 115559 kip-in



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PROJECT MnDOT SS-69801 J-3A.P4-Shear Strength - 1

PROJECT # 090147 DATE 2/22/10 BY jdf ^{✓ csm} _{5/17/10} SHEET NO. _____ OF _____

Determine V_n using Article 6.10.9

Section 4b (North or South end) ✓

Stiffener spacing = $d_o = 3'-0" = 36"$ ✓

End panel: 6.10.9.3.3.

$$V_n = V_{cr} = C V_p \checkmark$$

$C \Rightarrow$ See 6.10.9.3.2 -4, -5, or -6 based on $\frac{D}{t_w}$

$$D = 26" \checkmark$$

$$D/t_w = 69.33 \checkmark$$

$$t_w = .375 \checkmark$$

If $\frac{D}{t_w} \leq 1.12 \sqrt{\frac{E_k}{F_{yw}}}$ then use 6.10.9.3.2-4

$$k = 5 + \frac{5}{\left(\frac{d_o}{26}\right)^2} = 5 + \frac{5}{\left(\frac{36}{26}\right)^2} = 7.61 \checkmark$$

$$\frac{D}{t_w} = 69.33 \leq 1.12 \sqrt{\frac{29000 \times 7.61}{36}} = 87.7 \checkmark \therefore$$

Use 6.10.9.3.2-4.

$$C = 1.0 \checkmark$$

$$\begin{aligned} V_p &= 0.58 F_{yw} D t_w \checkmark \\ &= 0.58 \times 36 \times 26 \times .375 \times 2 = 407.2 \text{ kip.} \end{aligned}$$

2 webs

$$V_n = V_{cr} = 1.0 \times 407.2 = 407.2 \text{ kip.}$$



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PROJECT MoDOT SS-69801 J-3A.P4. Shear Strength -2

PROJECT # 090147 DATE 2/23/10 BY jdf ^{✓ CSM} _{5/17/10} SHEET NO. _____ OF _____

Section 4c (@ girder E)

$$\text{Stiffener spacing} = d_o = 1' - 0\frac{5}{16}" = 12.3" \quad \checkmark$$

Interior Panels, 6, 10, 9, 3, 2

Check $\frac{2 D t_w}{(b_{fc} t_{fc} + b_{ft} t_{ft})} < 2.5 \quad \checkmark$

$$D = 42"$$

$$t_w = 1" \quad \checkmark 2 \text{ webs}$$

$$\frac{2 \times 42 \times 1 \times 2}{(42 \times 3 + 36 \times .75)} = 1.098 < 2.5 \quad \text{OK} \quad \checkmark$$

$$V_n = V_p \left[C + \frac{0.87 (1-C)}{\sqrt{1 + \left(\frac{d_o}{D}\right)^2}} \right]$$

$$V_p = 0.58 \times F_{yw} \times D \times t_w = 0.58 \times 36 \times 42 \times 1" \times 2 \quad \checkmark 2 \text{ webs}$$

$$= 1753.9 \text{ k.p.} \quad \checkmark$$

$$C \Rightarrow \frac{D}{t_w} = \frac{42}{1} = 42$$

$$K = 5 + \frac{5}{\left(\frac{d_o}{D}\right)^2} = 5 + \frac{5}{\left(\frac{12.3}{42}\right)^2} = 63.3 \quad \checkmark$$

$$1.12 \sqrt{\frac{E K}{F_{yw}}} = 1.12 \sqrt{\frac{29000 \times 63.3}{36}} = 252 \quad \text{OK}$$

$$\frac{D}{t_w} \leq 1.12 \sqrt{\frac{E K}{F_{yw}}} \quad \therefore C = 1.0 \quad \checkmark$$

$$V_n = 1753.9 \left[1 + 0 \right] = 1753.9 \text{ k.p.} \quad \checkmark$$



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PROJECT MnDOT SS-69801J-3A.P4. Shear Strength - 3
PROJECT # 090147 DATE 2/23/10 BY jdf ✓ CSM
SHEET NO. _____ OF _____
5/17/10

Section 4j (@ support)

$$\text{Stiffener Spacing} = 3' - 0\frac{7}{8}" = 36.9" = d_o$$

Interior Panel, 6.10.9.3.0

$$\text{Check } \frac{2Dt_w}{(b_{fc}t_{fc} + b_{ft}t_{ft})} \leq 2.5$$

OK by comparison
to section 4e.

$$D = 43.625" \checkmark$$

$$V_n = V_p \left[C + \frac{0.87(1-C)}{\sqrt{1 + \left(\frac{D}{b} \right)^2}} \right]$$

$$V_p = 0.58 \times 36 \times 43.625" \times 1" \times 2 \stackrel{\checkmark}{=} 1821.8 \text{ kip} \quad \checkmark \text{ 2 webs}$$

$$C \Rightarrow \frac{D}{t_w} = \frac{43.625}{1"} = 43.625$$

$$k = 5 + \frac{5}{(d_o/D)^2} = 5 + \frac{5}{(36.9/43.625)^2} = 12.0 \checkmark$$

$$1.12 \sqrt{\frac{E_k}{F_{yw}}} = 1.12 \sqrt{\frac{29000 \times 12.0}{36}} = 110.1 \checkmark$$

$$D/t_w \leq 1.12 \sqrt{\frac{E_k}{F_{yw}}} \therefore C = 1.0$$

$$V_n = 1821.8 \text{ kip} \checkmark$$

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PROJECT Mn DOT SS-69801J-P4.3A - Shear Strength -4
PROJECT # 090147 DATE 2/23/10 BY jdf SHEET NO. _____ OF _____

✓
5/17/16

Section 4K (3' North of Girder B)

Stiffener Spacing = $d_o = 3'-0" = 36"$ ✓

Interior panels, 6.10.9.3.2 ✓

Check $\frac{2 D t_w}{(b_{fc} t_{fc} + b_{ft} t_{ft})}$

$$D = 41.875" ✓$$

$$t_w = .375" ✓$$

$$\frac{2 \times 41.875 \times .375 \times 2}{(36 \times .75 + 36 \times .75)} = 1.163 < 2.5 \text{ OK}$$

$$V_n = V_p \left[C + \frac{0.87(1-C)}{\sqrt{1 + \left(\frac{d_o}{D}\right)^2}} \right]$$

$$C \Rightarrow \frac{D}{t_w} = \frac{41.875}{.375} = 111.67 ✓$$

$$k = 5 + \frac{5}{\left(\frac{d_o}{D}\right)^2} = 5 + \frac{5}{\left(\frac{36}{41.875}\right)^2} = 11.77 ✓$$

$$1.12 \sqrt{\frac{E k}{F_{yw}}} = 1.12 \sqrt{\frac{29000 \times 11.77}{36}} = 109.0 ✓$$

$$1.40 \sqrt{\frac{E k}{F_{yw}}} = 136.32 ✓$$

$$1.12 \sqrt{\frac{E k}{F_{yw}}} < \frac{D}{t_w} < 1.40 \sqrt{\frac{E k}{F_{yw}}} \therefore \text{Use 6.10.9.3.2-5}$$

$$C = \frac{1.12}{\left(\frac{D}{t_w}\right)} \sqrt{\frac{E k}{F_{yw}}} = \frac{1.12}{111.67} \sqrt{\frac{29000 \times 11.77}{36}} = 0.977 ✓$$

$$V_p = 0.58 F_{yw} D t_w$$

$$= 0.58 \times 36 \times 41.875 \times .375 \times 2 = 655.8 \text{ kip.} ✓$$

$$V_n = 655.8 \left[.977 + \frac{.87(1-.977)}{\sqrt{1 + \left(\frac{36}{41.875}\right)^2}} \right] = 650.7 \text{ kip.} ✓$$

M-28



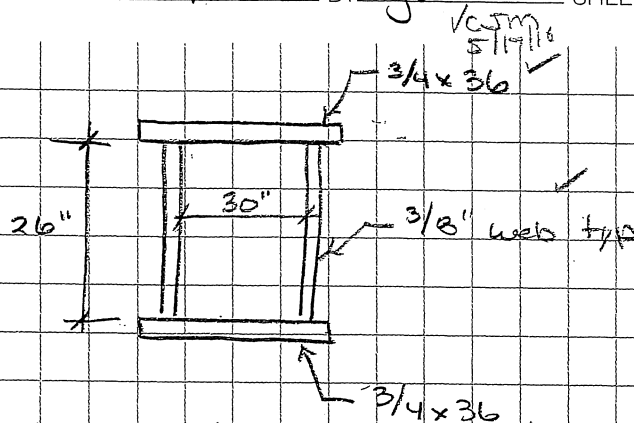
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PROJECT MnDOT SS-69801 J-3A.P4 - Torsional Sections

PROJECT # 090147 DATE 2/23/10 BY jdF SHEET NO. _____ OF _____

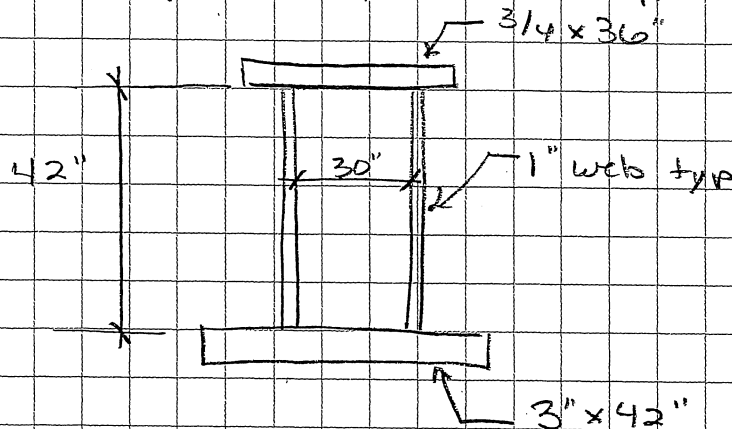
Section 4b



$$\frac{b}{t} = \frac{30.375}{.75} = 40.5$$
$$\frac{b}{t} = \frac{26.75}{.375} = 71.33$$
$$\frac{b}{t} > 10 \text{ OK}$$

$$A_o = (30 + 3/8) \times (26 + 3/4) = 812.5 \text{ in}^2$$

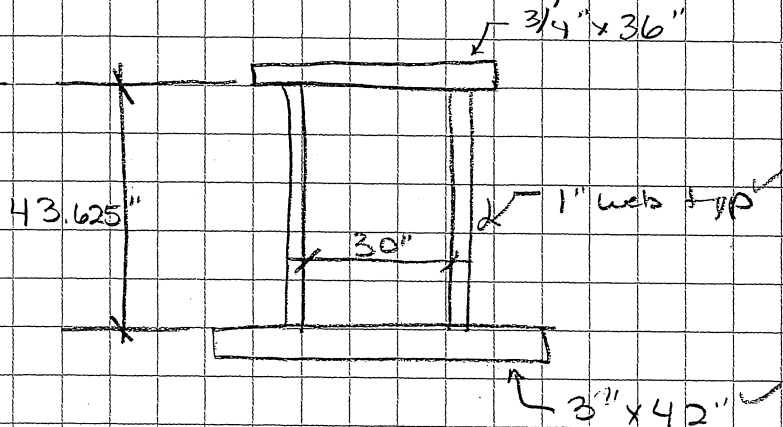
Section 4e



$$\frac{b}{t} = \frac{31}{3} = 10.33$$
$$\frac{b}{t} > 10 \text{ OK}$$

$$A_o = (30 + 1) \times (42 + \frac{1}{2} \times \frac{3}{4} + \frac{1}{2} \times 3) = 1360.1 \text{ in}^2$$

Section 4j



$$\frac{b}{t} > 10 \text{ OK}$$

$$A_o = (30 + 1) \times (43.625 + \frac{1}{2} \times \frac{3}{4} + \frac{1}{2} \times 3) = 1410.5 \text{ in}^2$$



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PROJECT mnDOT SS-69801J-3A-P4. Torsion/Shear Stress
PROJECT # 090147 DATE 2/23/10 BY jdf SHEET NO. 5/17/10 OF 5/17/10

Per AISC Design Guide 9, (4.6)

$$F_v = \tau_b + \tau_t \quad \checkmark \quad (4.10)$$

$\uparrow$ shear stress from applied shear (bending loads)
 $\uparrow$ torsional shear stress.

We want V in a force to place into our Rating equation

$$\tau_b = \frac{V_{\text{bending}}}{A_v} \quad \checkmark \quad (4.11) \quad A_v = D \times t_w \times 2$$

$\uparrow$ 2 webs.

$$F_v = \frac{V}{A_v} \quad \checkmark$$

$$\tau_t = \frac{T}{2t A_o} \quad \checkmark \quad (4.4)$$

$$\frac{V}{A_v} = \frac{V_{\text{bending}}}{A_v} + \frac{T}{2t A_o} \quad \checkmark$$

multiply both sides by A_v

$$V = V_{\text{bending}} + \frac{T \times D \times t_w \times 2}{2 \times t_w \times A_o} \quad \checkmark$$

$$V = V_{\text{bending}} + \frac{T \times D}{A_o} \quad \checkmark$$



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PROJECT MnDOT SS-69801J-P4.3A-Transverse Stiffeners - 1
PROJECT # 090147 DATE 2/23/10 BY jdf SHEET NO. _____ OF _____

Verify the transverse stiffeners meet the requirements of Article 6.10.11.1.

Review Stiffener Type A @ $3/8"$ web: ✓
 $3/8"$ thick, 5" wide @ minimum. ✓

$$d_o = 36" \quad \checkmark$$

D stiffener = 44.9" ✓ (Use Section 4k) (3'-0" North of Girder B)

$$b_t \geq 2.0 + \frac{D}{30} = 2.0 + \frac{44.9}{30} = 3.50" \quad \text{OK} \quad b_t = 5" \quad \checkmark$$

$$16t_p \geq b_t \geq \frac{b_f}{4} \Rightarrow 16 \times \frac{3}{8} = 6" > 5" \geq \text{NA OK Use } 5"$$

Determine V_u and ϕV_c

$$V_u = 1.25 \times 129.1 + 1.75 \times 175.8 = 469.0 \text{ kip.}$$

$$\phi_v = 1.0$$

$$V_c \Rightarrow \text{per 6.10.9.2, } V_c = C V_p$$

$C \Rightarrow$ Equation 6.10.9.3.2-4 thru -6 w/ $k = 5.0$

$$P/t_w = \frac{44.9}{1.375} = 119.7 \quad \checkmark$$

$$1.12 \sqrt{\frac{E k}{F_{yw}}} = 1.12 \sqrt{\frac{29000 \times 5}{36}} = 71.1 \quad \checkmark$$

$$1.40 \sqrt{\frac{E k}{F_{yw}}} = 88.7 \quad \checkmark$$

Since $\frac{D}{t_w} > 1.40 \sqrt{\frac{E k}{F_{yw}}}$, use 6.10.9.3.2-6

$$C = \frac{1.57}{(P/t_w)^2} \left(\frac{E k}{F_{yw}} \right) = \frac{1.57}{119.7^2} \left(\frac{29000 \times 5}{36} \right) = 0.441 \quad \checkmark$$

$$V_p = 0.58 \times F_{yw} \times D \times t_w = 0.58 \times 36 \times 44.9 \times 0.375 \times 2 = 703.1 \text{ k}$$

$$V_c = 0.441 \times 703.1 = 310.1 \text{ kip.} \quad \checkmark$$

Since $V_u > \phi V_c$, use 6.10.11.1.3-7 or -8 ✓

$$I_t = \frac{b d^3}{3} = \frac{0.375 \times 5^3}{3} = 15.6 \text{ in}^4 \quad \checkmark$$

$$I_{ti} = b t_w^3 J = 36 \times 0.375^3 \times 2.05 = 3.89 \text{ in}^4 \quad \checkmark$$

$$J = \frac{2.5}{(d_o/b)^2} - 2.0 \geq 0.5 \quad \frac{2.5}{(36/45.8)^2} - 2.0 = 2.05 \geq 0.5$$

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PROJECT MnDOT SS-69801J-P4.3A-Transverse Stiffeners - 2

PROJECT # 090147 DATE 2/23/10 BY jdf SHEET NO. 1 OF 1

✓com
5/17/10

$$I_{t2} = \frac{D^4 p_k^{1.3}}{40} \left(\frac{F_{yw}}{E} \right)^{1.5} \checkmark$$

$$p_k = \text{larger of } \frac{F_{yw}}{F_{crs}} \text{ or } 1.0 \checkmark$$

$$F_{crs} = \frac{0.31 E}{\left(\frac{b_t}{t_p} \right)^2} \leq F_{ys}$$

$$= \frac{0.31 \times 29000}{\left(\frac{15}{.375} \right)^2} \checkmark$$

$$= 50.57 \leq 36$$

Use 36 ksi

$$I_{t2} = \frac{.449^4 \times 1.0^{1.3}}{40} \left(\frac{36}{29000} \right)^{1.5} = 4.44 \text{ in}^4 \checkmark$$

Since $I_{t2} > I_{t1}$, Use 6.10.11.1.3-7 ✓

$$I_t \geq I_{t2} + (I_{t2} - I_{t1}) \left(\frac{V_n - \phi_v V_{cr}}{\phi_v V_n - \phi_v V_{cr}} \right)$$

$V_n = 650.7 \text{ kip}$, see "Shear Strength Section 4k" ✓

$$I_t \geq 4.44 + (4.44 - 3.89) \left(\frac{469.0 - 1.0 \times 310.1}{1.0 \times 650.7 - 1.0 \times 310.1} \right) \checkmark$$

$$I_t \geq 4.70 \text{ in}^4 \quad \text{OK} \quad I_t = 15.6 \text{ in}^4 \checkmark$$

Stiffener A's are OK @ 3/8" webs, ✓



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PROJECT MnDOT SS-69801J - P4.3A - Transverse Stiffeners -3

PROJECT # 090147 DATE 2/23/10 BY jdf SHEET NO. _____ OF _____

VCSm
5/17/10

Review Stiffener Type A @ 1" web.
3/8" thick, 5" wide @ minimum.

$$d_o = 19.375" \checkmark$$

D stiffener = 45.875" (Use 4h) 1'-4 5/8" north of Girder B

$$b_t \geq 2.0 + \frac{D}{30} = 2.0 + \frac{45.9}{30} = 3.53" \text{ OK } b_t = 5" \checkmark$$

$$16 t_p \geq b_t \geq \frac{b_t}{4} \Rightarrow 16 \times \frac{3}{8} = 6" > 5" > \text{NA} \text{ OK Use } 5"$$

Determine V_u and $\phi_v V_{cr}$

$$V_u = 1.25 \times 129.1 + 1.75 \times 175.8 = 469.0 \text{ kip}$$

$$\phi_v = 1.0$$

$$V_{cr} \Rightarrow \text{per 6.10.9.2 } V_{cr} = C V_p$$

$$C \Rightarrow \text{Equation 6.10.9.3.2-4 thru -6 w/ } K = 5.0 \checkmark$$

$$D/t_w = 45.9/1 = 45.9 \checkmark$$

$$D/t_w < 1.12 \sqrt{\frac{E}{F_{yw}}} = 71.1 \therefore \text{Use 6.10.9.3.2-4}$$

$$C = 1.0 \checkmark$$

$$V_p = 0.58 \times F_{yw} \times D \times t_w = 0.58 \times 36 \times 45.9 \times 1" \times 2 = 1917 \text{ kip}$$

$$V_{cr} = 1.0 \times 1917 = 1917 \text{ kip}$$

Since $V_u < \phi V_{cr}$, use smaller of 6.10.11.1.3-1 or -2

$$I_{t1} = \frac{b d^3}{3} = \frac{1.375 \times 5^3}{3} = 15.6 \text{ in}^4 \checkmark$$

$$I_{t1} = b t_w^3 J$$

$$J = \frac{2.5}{\left(\frac{d_o}{D}\right)^2 - 2.0} \geq 0.5 \frac{2.5}{\left(\frac{19.375}{45.9}\right)^2 - 2.0} = 12.03$$

$$I_{t1} = 19.375 \times 1^3 \times 12.03 = 233.1 \text{ in}^4 \checkmark$$

$$I_{t2} = \frac{D^4 P_k^{1.3}}{40} \left(\frac{F_{yw}}{E} \right)^{1.5} \checkmark$$



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PROJECT MnDOT SS-69801 J - P4-3A - Transverse Stiffeners - 4

PROJECT # 090147 DATE 2/23/10 BY jdF SHEET NO. _____ OF _____

✓
VCSM
5/17/10

$\rho_t = \text{larger of } F_y/F_{crs} \text{ and } 1.0 \checkmark$

$$F_{crs} = \frac{0.31 E}{\left(\frac{b_t}{t_p}\right)^2} \leq F_{ys} \checkmark$$

$$= \frac{0.31 \times 29000}{\left(\frac{5}{.375}\right)^2} = 50.57 \leq 36 \checkmark \text{ use } 36$$

$$I_{t2} = \frac{\rho_t = 1.0}{40} \times 45.875^4 \times 1.0^{1.3} \left(\frac{36}{29000}\right)^{1.5} = 4.84 \text{ in}^4 \checkmark$$

Since $I_t = 15.6 > I_{t2} = 4.84 \checkmark$ OK

Stiffener A's are OK @ 1" webs. ✓

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PROJECT MnDOT SS-69801 J-P4.3A - Transverse Stiffeners - 5

PROJECT # 090147 DATE 2/23/10 BY jdf SHEET NO. 517110 OF 517110

Review Stiffener type B:

$\frac{11}{16}$ " thick (.6875") above girder bottom flange, $b_t = 5"$
 $\frac{3}{4}$ " below girder bottom flange (solid, full width).

Check as if it is a $\frac{11}{16} \times 5$ " stiffener, (.6875" x 5")

d_p = smaller of adjacent web panel widths = 12.625"

$D_{\text{stiffener}} = 44.75$ (Section 4f) @ Girder B.

$$b_f \geq 2.0 + \frac{D}{30} = 2.0 + \frac{44.75}{30} = 3.49" \quad \checkmark \text{ OK } b_t = 5"$$

$$16 + p \geq b_t \geq \frac{b_f}{4} \Rightarrow 16 \times .6875 = 11" > 5" > \text{N.A. Use } 5"$$

Determine V_u and ϕV_c

$$V_u = 1.25 \times (2007 + 152.5 \times 12 \times \frac{42.7}{1360.1}) + 1.75 \times (122.4 + 250.8 \times 12 \times \frac{42}{1360.1})$$

$$= 275.2 + 376.8 = 652.0 \text{ kip.}$$

$$\phi V = 1.0$$

$$V_{cr} \Rightarrow \text{per 6.10.9.2, } V_{cr} = C V_p$$

$$C = \text{Equation 6.10.9.3.2-4 thru -6 w/ } k = 5.0$$

$$D/t_w = 44.75/1 = 44.75$$

$$1.12 \sqrt{\frac{E K}{F_{yw}}} = 1.12 \sqrt{\frac{29000 \times 5}{36}} = 71.1$$

$$\text{Since } D/t_w < 1.12 \sqrt{\frac{E K}{F_{yw}}}, \text{ use 6.10.9.3.2-4}$$

$$C = 1.0$$

$$V_p = 0.58 \times F_{yw} \times D \times t_w = 0.58 \times 36 \times 44.75 \times 1.0 \times 2 = 1868.8 \text{ k}$$

$$V_{cr} = 1.0 \times 1868.8 = 1868.8 \text{ kip.}$$

Since $V_u < \phi V_{cr}$, Use smaller of 6.10.11.1.3-1 or -2

$$I_t = \frac{bd^3}{3} = \frac{.6875 \times 5^3}{3} = 28.6 \text{ in}^4$$

$$I_{t1} = b \cdot t_w^3$$

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PROJECT MnDOT SS-69801J, P4.3A-Transverse Stiffeners -6

PROJECT # 090147 DATE 2/23/10 BY jdf ✓com
SHEET NO. _____ OF _____
5/17/10

$$J = \frac{2.5}{\left(\frac{D}{D}\right)^2} - 2.0 \geq 0.5$$

$$= \frac{2.5}{\left(\frac{12.625}{44.75}\right)^2} - 2.0 = 29.41 \geq 0.5$$

$$I_{t1} = 12.625 \times 1^3 \times 29.41 = 371.3 \text{ in}^4$$

$$I_{t2} = \frac{D^4 p_t^{1.3}}{40} \left(\frac{F_{yw}}{E} \right)^{1.5}$$

$$p_t = \text{larger of } \frac{F_{yw}}{F_{crs}} \text{ and } 1.0$$

$$F_{crs} = \frac{0.31E}{\left(\frac{b_f}{t_p}\right)^2} \leq F_{ys}$$

$$= \frac{0.31 \times 29000}{\left(\frac{5}{16875}\right)^2} = 170.0 \text{ or } 36 \text{ use } 36 \text{ ksi}$$

$$p_t = 1.0$$

$$I_{t2} = \frac{44.75^4 \times 1.0^{1.3}}{40} \left(\frac{36}{29000} \right)^{1.5} = 4.38 \text{ in}^4$$

$$\text{Since } I_{t1} = 28.6 \text{ in}^4 > I_{t2} = 4.38 \text{ in}^4 \text{ OK}$$

Stiffener type B is OK



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PROJECT Mn DOT SS-69801J-P4.3A Transverse Stiffeners - 7
PROJECT # 090147 DATE 2/25/10 BY jdj SHEET NO. 1 OF 1

Review Stiffener Type C:

$\frac{3}{4}$ " thick, 5" wide @ minimum.

$d_o = \text{smaller of } 36.9" \text{ or } 12.625" \text{ Use } 12.625"$

D Stiffener = $42" + 1.02' \times 0.56' / 1' \times 12' / 1' = 42.7"$
@ 4e @ slope and distance frame 4e

$b_t \geq 2.0 + \frac{P}{30} = 2.0 + \frac{42.7}{30} = 3.42"$ OK $b_t = 5"$
 $16tp \geq b_t \geq \frac{b_f}{4} \Rightarrow 16 \times \frac{3}{4} = 12 \geq b_t = 5" > \text{N.A OK Use } 5"$

Determine V_u and ϕV_c .

$V_u = 1.25 \times 221.1 + 1.75 \times 180.6 = 592.4 \text{ kip}$

@ maximum Reaction w/ comp Torsion

or
 $V_u = 1.25 \times (196.4 + 166.7 \times 12 \times \frac{42}{1360.1}) + 1.75 \times (114.5 + 236.3 \times 12 \times \frac{42}{1360.1})$
 $= 276.4 + 353.6 = 630.0 \text{ kip}$ ← controls.

$\phi V_c = 1.0$

$V_c \Rightarrow \text{per 6.10.9.2, } V_c = C V_p$

$C = \text{Equation 6.10.9.3.2-4 thru -6 w/ } k = 5.0$

$C = 1.8 \text{ from experience w/ 1" web}$

$V_p = 0.58 \times F_y \times D \times t_w = 0.58 \times 36 \times 42.7 \times 1 \times 2 = 1783.2 \text{ k}$

Since $V_u < \phi V_c$, use smaller of 6.10.11.1.3-1 or -2

$I_t = \frac{b d^3}{3} = \frac{.75 \times 5^3}{3} = 3.125 \text{ in}^4$

$I_{t1} = b \times t_w^3 \times J$

$b = 12.625"$

$J = \frac{2.15}{(d_o/d)^2} - 2.0 \geq 0.5 \Rightarrow \frac{2.15}{(12.625/42.7)^2} - 2.0 = 26.6$

$I_{t1} = 12.625 \times 1^3 \times 26.6 = 335.8 \text{ in}^4$

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PROJECT Mn DOT 53-6980N-P4.3A Transverse Stiffeners -8

PROJECT # 090147 DATE 2/25/10 BY jdf SHEET NO. 5/17/10 OF 63M

$$I_{t2} = \frac{D^4 P_t^{1.3}}{40} \left(\frac{F_{yw}}{E} \right)^{1.5}$$

$P_t = \text{larger of } \frac{F_{yw}}{F_{crs}} \text{ and } 1.0$

$$F_{crs} = \frac{0.31 E}{(b_e/t_p)^2} = \frac{0.31 \times 29000}{(5/1.75)^2} = 202.3 \text{ or } 36 \text{ Use } 36 \text{ ksi}$$

$$P_t = 1.0$$

$$I_{t2} = \frac{42.7^4 \times 1.0^{1.3}}{40} \left(\frac{36}{29000} \right)^{1.5} = 3.64 \text{ in}^4$$

Since $I_t = 31.25 \text{ in}^4 > I_{t2} = 3.64 \text{ in}^4$ OK

Stiffener type C is OK

M-38

Beam: **M1**

Shape: **BR3A-4a-RevisedJ**

Material: **A36 Steel**

Length: **21.353 ft**

I Joint: **N2**

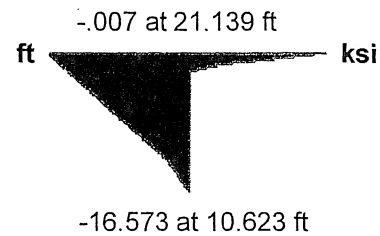
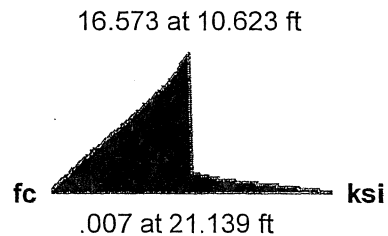
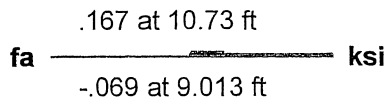
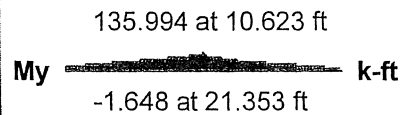
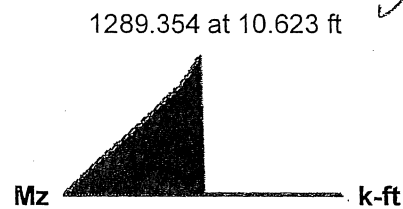
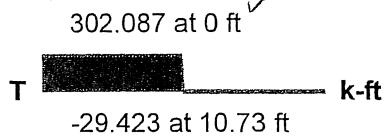
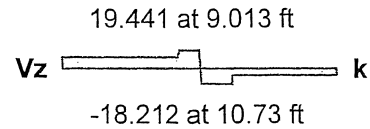
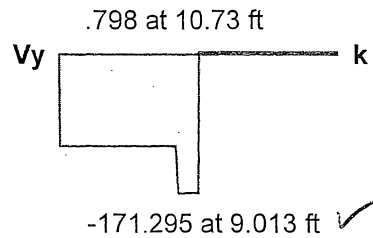
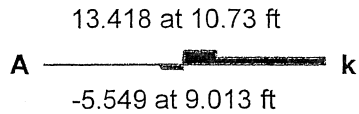
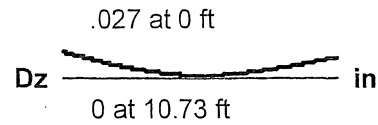
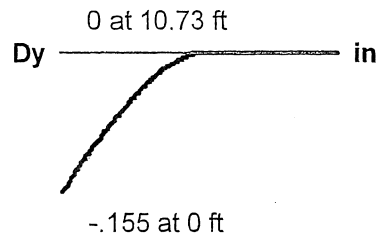
J Joint: **N6**

LC 69: **Std C200j T**

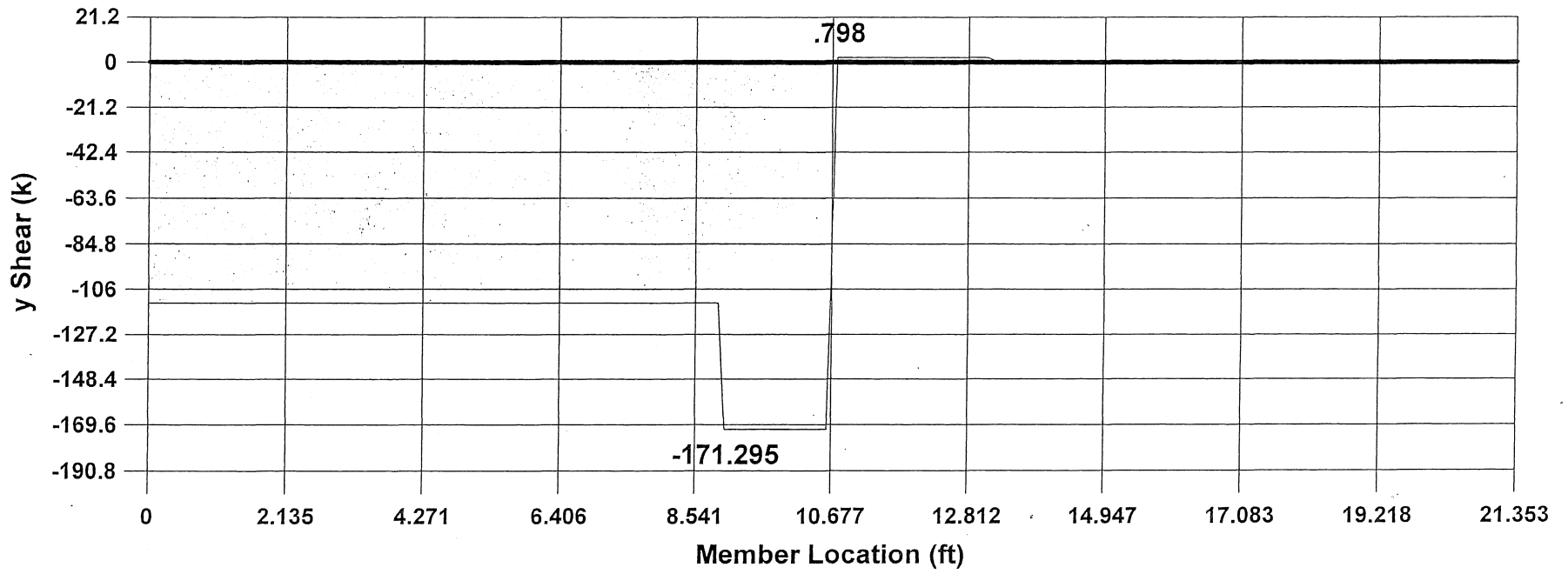
Code Check: **0.000 (bending)**

Report Based On 200 Sections

✓ 5/17/10



Member M1 , LC 69: Std C200j T



$$V_y @ 0 = 112.463 \text{ k}$$

UCSM
5/17/16

M-40

69801J-9A-P4
HL-93 RATING



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PROJECT MnDOT SS-69801J-3A.P4 - RF Moment @ C - one lane

PROJECT # 090147 DATE 3/18/10 BY jdf

5/17/10

SHEET NO. OF

Determine the rating factor at section -C located at the transition of $\frac{3}{8}$ " to 1" web on the southern side @ 14.99' (use 14.947')

$$R_n = m_{n,c} = 31589 \text{ kip}\cdot\text{in}$$

$$M_{nt} = 50598 \text{ kip}\cdot\text{in}$$

$$M_{DL} = 650.8 \text{ kip}\cdot\text{ft} = 7809.6 \text{ kip}\cdot\text{in}$$

$$M_{LL+I}(x) = 664.94 \text{ kip}\cdot\text{ft}$$

$$M_{LL+I}(y) = 19.7 \text{ kip}\cdot\text{ft}$$

$$S_x(\text{comp}) = 2223.25 \text{ in}^3$$

$$S_x(\text{ten}) = 2223.25 \text{ in}^3$$

$$S_y = 1104.12 \text{ in}^3$$

$$RF = \frac{C - \gamma_{DL} \times DL}{\gamma_{LL}(LL + Im)}$$

$$\gamma_{DL} = 1.25$$

$$\gamma_{LL} = 1.35 \text{ oper}$$

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

Compression will control.

$$C \phi = .85 = \phi_c \phi_s \phi R_n = 1.0 \times .85 \times 1.0 \times 31589 = 26851 \text{ kip}\cdot\text{in}$$

$$C \phi = .95 = 1.0 \times .95 \times 1.0 \times 31589 = 30010 \text{ kip}\cdot\text{in}$$

$$LL + Im = m_x + \frac{1}{3} \frac{m_y}{S_y} \times S_{xc} = (664.94 + \frac{1}{3} \times \frac{19.7}{1104.12} \times 2223.25) \times 12 \text{ in} = 8138.0 \text{ kip}\cdot\text{in}$$

$$R_{F,.85} = \frac{26851 - 1.25 \times 7809.6}{(1.35 \text{ or } 1.75) \times 8138.0}$$

$$\Rightarrow \left. \begin{array}{l} RF_{oper} = 1.56 \\ RF_{inv} = 1.20 \end{array} \right\} \phi_s = 0.85$$

$$\Rightarrow \left. \begin{array}{l} RF_{oper} = 1.84 \\ RF_{inv} = 1.42 \end{array} \right\} \phi_s = 0.95$$

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PROJECT MnDOT 53-69801J - 3A.P4 - RF Moment @ C - two lanes

PROJECT # 090147 DATE 2/22/10 BY jdf SHEET NO. _____ OF _____

$\checkmark$ C+M
5/17/10

Determine the rating factor at section - C,
located at the transition of 3/8" to 1" web
on the southern side.

$$R_n = M_{nc} = 31589 \text{ kip}\cdot\text{in} \quad M_{nt} = 50598 \text{ kip}\cdot\text{in}$$

$$\begin{aligned} M_{DL} &= 650.8 \text{ kip}\cdot\text{ft} = 7809.6 \text{ kip}\cdot\text{in} \\ M_{LL+I(x)} &= 555.6 \text{ kip}\cdot\text{ft} = 6667.2 \text{ kip}\cdot\text{in} \\ M_{LL+I(y)} &= 33.5 \text{ kip}\cdot\text{ft} = 402.0 \text{ kip}\cdot\text{in} \\ S_x(\text{comp}) &= 2223.25 \text{ in}^3 \quad S_x(\text{ten}) = 2223.25 \text{ in}^3 \\ S_y &= 1104.12 \text{ in}^3 \end{aligned}$$

$$RF = \frac{C - \gamma_{DL} \times DL}{\gamma_{LL}(LL+Im)}$$

$$\gamma_{DL} = 1.25$$

$$\gamma_{LL} = 1.35 \text{ oper}, \gamma_{LL} = 1.75 \text{ inv.}$$

Compression will control.

$$\begin{aligned} C &= \phi_c \phi_s \phi R_n = 1.0 \times .85 \times 1.0 \times 31589 = 26850.6 \text{ kip}\cdot\text{in} \\ LL+Im &= m_x + \frac{1}{3} \frac{m_y}{S_y} \times S_{xc} = 6667.2 + \frac{1}{3} \times \frac{402.0}{1104.12} \times 2223.25 \\ &= 6937.0 \text{ kip}\cdot\text{in} \end{aligned}$$

$$RF = \frac{26850.6 - 1.25 \times 7809.6}{(1.35 \text{ or } 1.75) \times 6937.0} \Rightarrow \left. \begin{aligned} RF_{\text{oper}} &= 1.82 \\ RF_{\text{inv}} &= 1.41 \end{aligned} \right\} \phi_s = 0.85$$

$$C \text{ w/ } \phi_s = 0.95 = 30009 \text{ kip}\cdot\text{in}$$

$$\left. \begin{aligned} RF_{\text{oper}} &= 2.16 \\ RF_{\text{inv}} &= 1.67 \end{aligned} \right\} \phi_s = 0.95$$



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PROJECT MnDOT SS-69861 J-3A.P4.RF Moment @ h - one lane

PROJECT # 090147 DATE 3/18/10 BY jdf SHEET NO. 5/17/10 OF 5/17/10

Determine the Rating Factor at section -h, located where the bottom flange starts its transition 3/4" to 1" thick on the northern side.
(@ 7.52' use 7.53')

$$R_n = m_{nc} = 47181 \text{ kip}\cdot\text{in} \quad M_{nt} = 83201 \text{ kip}\cdot\text{in}$$

$$M_{DL} = 828.9 \text{ kip}\cdot\text{ft} = 9946.8 \text{ kip}\cdot\text{in}$$

$$M_{LL+I}(x) = 894.6 \text{ kip}\cdot\text{ft}$$

$$M_{LL+I}(y) = 27.8 \text{ kip}\cdot\text{ft}$$

$$S_x(\text{comp}) = S_x(\text{ten}) = 1918.4 \text{ in}^3$$

$$S_y = 1549.0 \text{ in}^3$$

$$RF = \frac{C - \gamma_{DL} \times DL}{\gamma_{LL}(LL+Im)}$$

$$\gamma_{DL} = 1.25$$

$$\gamma_{LL} = 1.35 \text{ oper.}, \gamma_{LL} = 1.75 \text{ inv.}$$

Compression flange will control.

$$C_{\phi_s=0.85} = \phi_c \phi_s R_n = 1.0 \times .85 \times 1.0 \times 47181 = 40104 \text{ kip}\cdot\text{in}$$

$$C_{\phi_s=.95} = 1.0 \times .95 \times 1.0 \times 47181 = 44822 \text{ kip}\cdot\text{in}$$

$$LL+Im = m_x + \frac{1}{3} \frac{m_y}{S_y} \times S_{xc} = \left(894.6 + \frac{1}{3} \times \frac{27.8}{1549.0} \times 1918.4 \right) \times 12''$$

$$= 10873 \text{ kip}\cdot\text{in}$$

$$RF = \frac{40104 - 1.25 \times 9946.8}{(1.35 \text{ or } 1.75) \times 10873}$$

$$\Rightarrow \left. \begin{array}{l} RF_{oper} = 1.89 \\ RF_{inv} = 1.45 \end{array} \right\} \phi_s = 0.85$$

$$\Rightarrow \left. \begin{array}{l} RF_{oper} = 2.21 \\ RF_{inv} = 1.70 \end{array} \right\} \phi_s = 0.95$$



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PROJECT MnDOT SS-69801J-3A.P4 · RF moment @ h - two lanes

PROJECT # 090147 DATE 2/22/10 BY jdf ✓
SHEET NO. 517/110 OF

Determine the Rating Factor at section - h,
located where the bottom flange starts its
transition $\frac{3}{4}$ " to 1" thick on the northern side.

$$R_n = m_{nc} = 47181 \text{ kip}\cdot\text{in} \quad M_{nt} = 83201 \text{ kip}\cdot\text{in}$$

$$M_{DL} = 828.9 \text{ kip}\cdot\text{ft} = 9946.8 \text{ kip}\cdot\text{in}$$

$$M_{LL+I}(x) = 801.5 \text{ kip}\cdot\text{ft} = 9618.0 \text{ kip}\cdot\text{in}$$

$$M_{LL+I}(y) = 46.5 \text{ kip}\cdot\text{ft} = 558.0 \text{ kip}\cdot\text{in}$$

$$S_x(\text{comp}) = 1918.4 \text{ in}^3$$

$$S_x(\text{ten}) = 1918.4 \text{ in}^3$$

$$S_y = 1549.0 \text{ in}^3$$

Revised to
45.6 kip·ft
did not
change
these
cases

$$RF = \frac{C - \gamma_{DL} \times DL}{\gamma_{LL}(LL+Im)}$$

$$\gamma_{DL} = 1.25$$

$$\gamma_{LL} = 1.35 \text{ oper}, \gamma_{LL} = 1.75 \text{ inv.}$$

Compression flange will control

$$C = \phi_c \phi_s R_n = 1.0 \times 0.85 \times 1.0 \times 47181 = 40104 \text{ kip}\cdot\text{in}$$

$$LL+Im = M_x + \frac{1}{3} \frac{m_y}{S_y} \times S_x = 9618.0 + \frac{1}{3} \times \frac{558.0}{1549.0} \times 1918.4$$

$$= 9848.4 \text{ kip}\cdot\text{in}$$

$$RF = \frac{40104 - 1.25 \times 9946.8}{(1.35 \text{ or } 1.75) \times 9848.4}$$

$$\Rightarrow \left. \begin{array}{l} RF_{oper} = 2.08 \\ RF_{inv} = 1.61 \end{array} \right\} \phi_s = 0.85$$

$$C \text{ w/ } \phi_s = 0.95 = 44822 \text{ kip}\cdot\text{in}$$

$$\left. \begin{array}{l} RF_{oper} = 2.44 \\ RF_{inv} = 1.88 \end{array} \right\} \phi_s = 0.95$$



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PROJECT MnDOT SS-69801 J-3A.P4 - RF moment @ i - one lane

PROJECT # 090147 DATE 3/18/10 BY jdf

5/17/10

SHEET NO. OF

Determine the Rating Factor at Section -i, located at the transition of 3/8" to 1" web on the northern side, (@ 7.16' use 7.193')

$$R_n = m_{nc} = 36067 \text{ kip}\cdot\text{in} \quad M_{nt} = 57018 \text{ kip}\cdot\text{in}$$

$$M_{OL} = 791.3 \text{ kip}\cdot\text{ft} = 9495.6 \text{ kip}\cdot\text{in}$$

$$M_{LL+I}(x) = 854.5 \text{ kip}\cdot\text{ft}$$

$$M_{LL+I}(y) = 26.6 \text{ kip}\cdot\text{ft}$$

$$S_x(\text{comp}) = S_x(\text{ten}) = 1458.0 \text{ in}^3$$

$$S_y = 755.9 \text{ in}^3$$

$$RF = \frac{C - \gamma_{DL} \times DL}{\gamma_{LL}(LL+IM)}$$

$$\gamma_{DL} = 1.25$$

$$\gamma_{LL} = 1.35 \text{ oper}, \quad \gamma_{LL} = 1.75 \text{ inv.}$$

Compression flange will control.

$$C_{\phi_s=0.85} = \phi_c \phi_s \phi R_n = 1.0 \times 0.85 \times 1.0 \times 36067 = 30657 \text{ kip}\cdot\text{in}$$

$$C_{\phi_s=0.95} = 1.0 \times 0.95 \times 1.0 \times 36067 = 34264 \text{ kip}\cdot\text{in}$$

$$LL+IM = m_x + \frac{1}{3} \frac{m_y}{S_y} \times S_{xc} = (854.5 + \frac{1}{3} \frac{26.6}{755.9} \times 1458.0) \times 12 \text{ in} \\ = 10458 \text{ kip}\cdot\text{in}$$

$$RF = \frac{30657 - 1.25 \times 9495.6}{(1.35 \text{ or } 1.75) \times 10458} \Rightarrow \begin{matrix} RF_{\text{oper}} = 1.33 \\ RF_{\text{inv}} = 1.03 \end{matrix} \quad \phi_s = 0.85$$

$$\Rightarrow \begin{matrix} RF_{\text{oper}} = 1.59 \\ RF_{\text{inv}} = 1.22 \end{matrix} \quad \phi_s = 0.95$$

N-5
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PROJECT MnDOT SS-69801J - 3A.P4. RF moment at i - two lanes

PROJECT # 090147 DATE 2/22/10 BY jdf 1/5m 5/17/10 SHEET NO. OF

Determine the Rating Factor at section - i
located at the transition of $\frac{3}{8}$ " to 1" web
on the northern side

$$R_n = M_{nc} = 36067 \text{ kip}\cdot\text{in} \quad M_{nt} = 57018 \text{ kip}\cdot\text{in}$$

$$M_{DL} = 791.3 \text{ kip}\cdot\text{ft} = 9495.6 \text{ kip}\cdot\text{in}$$

$$M_{LL+I(x)} = 765.6 \text{ kip}\cdot\text{ft} = 9187.2 \text{ kip}\cdot\text{in}$$

$$M_{LL+I(y)} = 44.6 \text{ kip}\cdot\text{ft} = 535.2 \text{ kip}\cdot\text{in}$$

$$S_x(\text{comp}) = 1458.0 \text{ in}^3 \quad S_x(\text{ten}) = 1458.0 \text{ in}^3$$

$$S_y = 755.9 \text{ in}^3$$

Revised to
43.7 kip-ft,
did not change
these
calcs

$$RF = \frac{C - \gamma_{DL} \times DL}{\gamma_{LL} (LL + Im)}$$

$$\gamma_{DL} = 1.25$$

$$\gamma_{LL} = 1.35 \text{ oper}, \gamma_{LL} \leq 1.75 \text{ inv.}$$

Compression flange will control.

$$C = \phi_c \phi_s \phi R_n = 1.0 \times 0.85 \times 1.0 \times 36067 = 30657 \text{ kip}\cdot\text{in}$$

$$LL + Im = m_x + \frac{1}{3} \frac{m_y}{S_y} \times S_{xc} = 9187.2 + \frac{1}{3} \times \left(\frac{535.2}{755.9} \right) \times 1458.0 = 9531.3 \text{ kip}\cdot\text{in}$$

$$RF = \frac{30657 - 1.25 \times 9495.6}{(1.35 \text{ or } 1.75) \times 9531.3} \Rightarrow \left. \begin{array}{l} RF_{\text{oper}} = 1.46 \\ RF_{\text{inv}} = 1.13 \end{array} \right\} \phi_s = 0.85$$

$$C \text{ w/ } \phi_s = 0.95 = 34264 \text{ kip}\cdot\text{in}$$

$$RF_{\text{oper}} = 1.74 \quad \left. \begin{array}{l} RF_{\text{oper}} = 1.74 \\ RF_{\text{inv}} = 1.34 \end{array} \right\} \phi_s = 0.95$$

$$RF_{\text{inv}} = 1.34$$



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PROJECT MnDOT SS-69801J-3A-P4-RF Moment at J - one lane
PROJECT # 090147 DATE 3/18/10 BY jdf ^{✓com} _{5/17/10} SHEET NO. _____ OF _____

Since the two lane Rating Factors are so high,
neither the one lane, nor two lane
conditions will control the RF. ✓

Therefore, assume the RF for one lane is a
bit lower than the two lane. ✓



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PROJECT Mn DOT SS-69801J-3A.P4-RF Moment at j - two lanes
PROJECT # 090147 DATE 2/22/10 BY jdF SHEET NO. _____ OF _____
5/17/10

Determine the Rating Factor at section -j.
Located at the support 4.

No but worth control ✓
 $R_n = M_{nc} = 247465 \text{ kip}\cdot\text{in}$ $M_{nt} = 115559 \text{ kip}\cdot\text{in}$

✓
 $M_{DL} = 1327.6 \text{ kip}\cdot\text{ft} = -15931.2 \text{ kip}\cdot\text{in}$ ✓
 $M_{LL+I(x)} = 1289.5 \text{ kip}\cdot\text{ft} = 15474.0 \text{ kip}\cdot\text{in}$ ✓
 $M_{LL+I(y)} = 74.6 \text{ kip}\cdot\text{ft} = 895.2 \text{ kip}\cdot\text{in}$ ✓
 $S_x(\text{comp}) = 4837.2 \text{ in}^3$ $S_x(\text{ten}) = 2258.8 \text{ in}^3$ ✓
 $S_y = 2019.4 \text{ in}^3$ ✓
Revised to 73.7 kip-ft. did not change these calcs.

$RF = \frac{C - \gamma_{DL} \times DL}{\gamma_{LL} (LL + IM)}$ $\gamma_{DL} = 1.25$
 $\gamma_{LL} = 1.35 \text{ oper}, \gamma_{LL} = 1.75 \text{ inv.}$

Tension Flange will control.

✓
 $C = \phi_c \phi_s \phi R_n = 1.0 \times 0.85 \times 1.0 \times 115559 = 98225 \text{ kip}\cdot\text{in}$ ✓
 $LL + IM = M_x + \frac{1}{3} \frac{m_y}{S_y} \times S_{xt} = 15474 + \frac{1}{3} \times \frac{895.2}{2019.4} \times 2258.8$ ✓
 $= 15807.8 \text{ kip}\cdot\text{in}$

$RF = \frac{98225 - 1.25 \times 15931.2}{(1.35 \text{ or } 1.75) \times 15807.8} \Rightarrow RF_{oper} = 3.67$ ✓
 $RF_{inv} = 2.83$ ✓

✓
 $C: w/ \phi_s = 0.95 = 109781.0 \text{ kip}\cdot\text{in}$

$RF_{oper} = 4.21$ ✓
 $RF_{inv} = 3.25$ ✓



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PROJECT Mn DOT SS-69801 J-3A-P4. RE Shear - one lane - 1

PROJECT # 090147 DATE 3/18/10 BY Jdf SHEET NO. 1 OF 1

initials Jdf
reflect 6/25/10

RE for between A+B, Use section 4b.

$$R_n = 407.2 \text{ kip}$$

$$V_{DL} = 129.1 \text{ k} \quad \leftarrow \text{see two lanes}$$

$$V_{LL+I} = 118.8 + \frac{25.7 \text{ kip} \cdot \text{ft} \times 12''/1' \times 26}{812.5} = 128.7 \text{ kip}$$

$$RF = \frac{1.0^3 \times 407.2 - 1.25 \times 129.1}{(1.35 \text{ or } 1.75) \times 128.7} \Rightarrow \begin{matrix} \text{oper} = 1.41 \text{ } 1.38 \\ \text{inv} = 1.09 \text{ } 1.06 \end{matrix}$$

RE between E+F, Use section 4b.

Will not control when compared to section
between A+B.

Check shear between A+B w/ maximum Torque and
accompanying gravity loads. Use Section 4b.

$$R_n = 407.2 \text{ k}$$

$$V_{DL} = 129.1 \text{ k}$$

$$V_{LL+I} = 79.8 + \frac{250 \text{ kip} \cdot \text{ft} \times 12''/1' \times 26}{812.5 \text{ in}^2} = 175.8 \text{ kip}$$

$$RF = \frac{1.0^3 \times 407.2 - 1.25 \times 129.1}{(1.35 \text{ or } 1.75) \times 175.8} \Rightarrow \begin{matrix} \text{oper} = 1.01 \\ \text{inv} = 0.80 \text{ } 0.78 \end{matrix}$$

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PROJECT MnDOT SS-69801 J-3A-P4 RF Shear - two lane - 1

PROJECT # 090147 DATE 2/23/10 BY jdF SHEET NO. _____ OF _____

RF for between A & B

Use Section 4b.

$$R_n = 407.2 \text{ kip.}$$

$$V_{DL} = V_{\text{bending}} + \frac{T \times D}{A_o} = 108.9 + \frac{52.5 \text{ kip-ft} \times 12" / 1' \times 26"}{812.5 \text{ in}^2} = 129.1 \text{ kip.}$$

$$V_{LL+I} = 106.5 \text{ k} + \frac{30.8 \text{ kip-ft} \times 12" / 1' \times 26"}{812.5} = 118.3 \text{ kip.}$$

$$RF = \frac{1.0^3 \times 407.2 - 1.25 \times 129.1}{(1.35 \text{ or } 1.75) \times 118.3} \Rightarrow \begin{matrix} \text{oper} = 1.54 \\ \text{inv} = 1.19 \end{matrix}$$

RF between E & F, Use Section 4b.

$$R_n = 407.2 \text{ kip}$$

$$V_{DL} = V_{\text{bending}} + \frac{T \times D}{A_o} = 100.6 + \frac{66.7 \text{ kip-ft} \times 12" / 1' \times 26"}{812.5 \text{ in}^2} = 126.2 \text{ kip}$$

$$V_{LL+I} = 86.7 + \frac{29.0 \text{ kip-ft} \times 12" / 1' \times 26"}{812.5 \text{ in}^2} = 97.8 \text{ kip}$$

$$RF = \frac{1.0^3 \times 407.2 - 1.25 \times 126.2}{(1.35 \text{ or } 1.75) \times 97.8} \Rightarrow \begin{matrix} \text{oper} = 1.89 \\ \text{inv} = 1.46 \end{matrix}$$



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PROJECT MnDOT SS-698011-3A.P4 RF Shear - two lanes -2

PROJECT # 090147 DATE 2/23/10 BY jdf VCSM SHEET NO. OF

RF for between B and Support, Use Section 4j

$$R_n = 1821.8 \text{ kip}$$

$$V = V_{\text{bending}} + \frac{I \times D}{A_o}$$

$$V_{DL} = 260.7 + \frac{52.5 \text{ kip} \cdot \text{ft} \times 12' / 1 \times 43.625''}{1410.5 \text{ in}^2} = 220.2 \text{ kip}$$

$$V_{LL+I} = 198.5 + \frac{30.8 \text{ kip} \cdot \text{ft} \times 12' / 1 \times 43.625''}{1410.5 \text{ in}^2} = 198.5 \text{ kip}$$

$$RF = \frac{1.0^3 \times 1821.8 - 1.25 \times 220.2}{(1.35 \text{ or } 1.75) \times 198.5} \Rightarrow \begin{matrix} \text{oper} = 5.77 & 5.44 \\ \text{inv} = 4.45 & 4.19 \end{matrix}$$

RF for between Support and E, Use Section 4e

$$R_n = 1753.9 \text{ kip}$$

$$V = V_{\text{bending}} + \frac{I \times D}{A_o}$$

$$V_{DL} = 196.4 + \frac{66.7 \text{ kip} \cdot \text{ft} \times 12' / 1 \times 42''}{1360.1 \text{ in}^2} = 221.1 \text{ k}$$

$$V_{LL+I} = 169.9 + \frac{29.0 \text{ kip} \cdot \text{ft} \times 12' / 1 \times 42''}{1360.1 \text{ in}^2} = 180.6 \text{ k}$$

$$RF = \frac{1.0^3 \times 1753.9 - 1.25 \times 221.1}{(1.35 \text{ or } 1.75) \times 180.6} \Rightarrow \begin{matrix} \text{oper} = 6.06 \uparrow \\ \text{inv} = 4.67 \uparrow \end{matrix}$$

will go up
4.70

N-11



21 West Superior Street, Suite 500
Duluth, Minnesota 55802
218 727-8446
Fax 218 727-8456
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250 3rd Avenue North, Suite 450
Minneapolis, Minnesota 55401
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PROJECT MnDOT SS-69801J-3A.P4. RF Shear - two lanes - 3

PROJECT # 090147 DATE 2/23/10 BY jdf SHEET NO. OF

initial 5/7/10 reviewed 6/25/10

RF shear between A and B with maximum
Torque and accompanying gravity loads.
Use Section 4B.

$$R_n = 407.2 \text{ kip} \checkmark$$

$$V = V_{\text{bending}} + \frac{T \times D}{A_o}$$

$$V_{DL} = 108.9 + \frac{52.5 \text{ kip} \cdot \text{ft} \times 12 \text{ " / 1} \times 26 \text{ "}}{812.5 \text{ in}^2} = 129.1 \text{ kip} \checkmark$$

$$V_{LL+I} = 72.3 + \frac{218.3 \text{ kip} \cdot \text{ft} \times 12 \text{ " / 1} \times 26 \text{ "}}{812.5 \text{ in}^2} = 156.1 \text{ kip} \checkmark$$

$$RF = \frac{1.0^3 \times 407.2 - 1.25 \times 129.1}{(1.35 \text{ or } 1.75) \times 156.1} \Rightarrow \begin{matrix} \text{oper} = 1.17 & 1.13 \checkmark \\ \text{inv} = 0.90 & 0.88 \checkmark \end{matrix}$$

69801J-34PA
POSTING + PERMIT

Company : LHB
Designer : jdf
Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 26, 2010
10:19 AM
Checked By: *CJM*

5/11/10

Load Combinations (Continued)

	Description	Sol...	PD...	SR...	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor
57	P4-3A SU5 Tor	Yes			35	1													
58	P4-3A SU6 Tor	Yes			36	1													
59	P4-3A SU7 Tor	Yes			37	1													
60	P4-3A Std A Tor	Yes			38	1													
61	P4-3A Std B Tor	Yes			39	1													
62	P4-3A Std C Tor	Yes			40	1													
63	P4-3A P411 Tor	Yes			41	1													
64	P4-3A P413 Tor	Yes			42	1													
65	P4-3A C152b Tor	Yes			43	1													
66	P4-3A C174b Tor	Yes			44	1													
67	P4-3A C198_23 Tor	Yes			45	1													
68	P4-3A C124b Tor	Yes			46	1													
69	P4-3A C237b Tor	Yes			47	1													
70	P4-3A C256b Tor	Yes			48	1													
71	P4-3A C200j Tor	Yes			49	1													
72	PERMIT-STD-C152B-LO...	Yes			M23	1													
73	PERMIT-STD-C174B-LO...	Yes			M24	1													
74	PERMIT-STD-C198_23-L...	Yes			M25	1													
75	PERMIT-STD-C214B-LO...	Yes			M26	1													
76	PERMIT-STD-C237B-LO...	Yes			M27	1													
77	PERMIT-STD-C256B-LO...	Yes			M28	1													

Post - Type 3 unit

5/11/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	15	1.163	15	0	15	0	15	0	15	0	15
2		min	0	15	-1.191	15	0	15	0	15	0	15	0	15
3	P3-3C	max	0	15	.963	15	0	15	0	15	0	15	0	15
4		min	0	15	-5.875	15	0	15	0	15	0	15	0	15
5	P2-3C	max	0	15	47.377	15	0	15	0	15	0	15	0	15
6		min	0	15	-3.779	15	0	15	0	15	0	15	0	15
7	P1-3C	max	0	15	47.938	15	0	15	0	15	0	15	0	15
8		min	0	15	-.608	15	0	15	0	15	0	15	0	15
9	P7-3A	max	0	15	49.563	15	0	15	0	15	0	15	0	15
10		min	0	15	-5.978	15	0	15	0	15	0	15	0	15
11	P6-3A-FTG	max	0	15	47.534	15	0	15	0	15	0	15	0	15
12		min	0	15	-5.614	15	0	15	0	15	0	15	0	15
13	P5-3A-FTG	max	0	15	48.79	15	0	15	0	15	0	15	0	15
14		min	0	15	-4.213	15	0	15	0	15	0	15	0	15
15	P4-3A-FTG	max	0	15	0	15	0	15	0	15	0	15	0	15
16		min	0	15	0	15	0	15	0	15	0	15	0	15
17	P4-3A	max	0	15	47.273	15	0	15	0	15	0	15	116.577	15
18		min	0	15	-4.852	15	0	15	0	15	0	15	-117.977	15
19	P3-3A-FTG	max	0	15	46.929	15	0	15	0	15	0	15	0	15
20		min	0	15	-4.569	15	0	15	0	15	0	15	0	15
21	P2-3A	max	0	15	46.966	15	0	15	0	15	0	15	0	15
22		min	0	15	-4.464	15	0	15	0	15	0	15	0	15
23	P1-3A	max	0	15	36.971	15	0	15	0	15	0	15	0	15
24		min	0	15	-3.85	15	0	15	0	15	0	15	0	15
25	H5	max	0	15	0	15	0	15	0	15	0	15	0	15
26		min	0	15	0	15	0	15	0	15	0	15	0	15
27	Totals:	max	0	15	48	15	0	15						
28		min	0	15	14	15	0	15						

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 15, 2010
 1:39 PM
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Post - Type 3S2-40 Unit

5/11/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	16	1.642	16	0	16	0	16	0	16	0	16
2		min	0	16	-227	16	0	16	0	16	0	16	0	16
3	P3-3C	max	0	16	1.148	16	0	16	0	16	0	16	0	16
4		min	0	16	-8.297	16	0	16	0	16	0	16	0	16
5	P2-3C	max	0	16	66.247	16	0	16	0	16	0	16	0	16
6		min	0	16	-4.504	16	0	16	0	16	0	16	0	16
7	P1-3C	max	0	16	72.66	16	0	16	0	16	0	16	0	16
8		min	0	16	-798	16	0	16	0	16	0	16	0	16
9	P7-3A	max	0	16	65.255	16	0	16	0	16	0	16	0	16
10		min	0	16	-8.393	16	0	16	0	16	0	16	0	16
11	P6-3A-FTG	max	0	16	73.452	16	0	16	0	16	0	16	0	16
12		min	0	16	-6.344	16	0	16	0	16	0	16	0	16
13	P5-3A-FTG	max	0	16	68.618	16	0	16	0	16	0	16	0	16
14		min	0	16	-5.624	16	0	16	0	16	0	16	0	16
15	P4-3A-FTG	max	0	16	0	16	0	16	0	16	0	16	0	16
16		min	0	16	0	16	0	16	0	16	0	16	0	16
17	P4-3A	max	0	16	69.298	16	0	16	0	16	0	16	130.232	16
18		min	0	16	-5.547	16	0	16	0	16	0	16	-141.369	16
19	P3-3A-FTG	max	0	16	66.273	16	0	16	0	16	0	16	0	16
20		min	0	16	-4.977	16	0	16	0	16	0	16	0	16
21	P2-3A	max	0	16	66.33	16	0	16	0	16	0	16	0	16
22		min	0	16	-4.874	16	0	16	0	16	0	16	0	16
23	P1-3A	max	0	16	41.336	16	0	16	0	16	0	16	0	16
24		min	0	16	-4.352	16	0	16	0	16	0	16	0	16
25	H5	max	0	16	0	16	0	16	0	16	0	16	0	16
26		min	0	16	0	16	0	16	0	16	0	16	0	16
27	Totals:	max	0	16	80	16	0	16						
28		min	0	16	12	16	0	16						

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 15, 2010
 1:39 PM
 Checked By: *ju*

Post - Type 353 Unit

5/11/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	17	1.699	17	0	17	0	17	0	17	0	17
2		min	0	17	-0.245	17	0	17	0	17	0	17	0	17
3	P3-3C	max	0	17	1.236	17	0	17	0	17	0	17	0	17
4		min	0	17	-8.585	17	0	17	0	17	0	17	0	17
5	P2-3C	max	0	17	68.144	17	0	17	0	17	0	17	0	17
6		min	0	17	-4.847	17	0	17	0	17	0	17	0	17
7	P1-3C	max	0	17	73.942	17	0	17	0	17	0	17	0	17
8		min	0	17	-8.837	17	0	17	0	17	0	17	0	17
9	P7-3A	max	0	17	68.598	17	0	17	0	17	0	17	0	17
10		min	0	17	-8.697	17	0	17	0	17	0	17	0	17
11	P6-3A-FTG	max	0	17	74.51	17	0	17	0	17	0	17	0	17
12		min	0	17	-6.622	17	0	17	0	17	0	17	0	17
13	P5-3A-FTG	max	0	17	69.225	17	0	17	0	17	0	17	0	17
14		min	0	17	-5.891	17	0	17	0	17	0	17	0	17
15	P4-3A-FTG	max	0	17	0	17	0	17	0	17	0	17	0	17
16		min	0	17	0	17	0	17	0	17	0	17	0	17
17	P4-3A	max	0	17	70.792	17	0	17	0	17	0	17	141.822	17
18		min	0	17	-6.008	17	0	17	0	17	0	17	-151.304	17
19	P3-3A-FTG	max	0	17	68.026	17	0	17	0	17	0	17	0	17
20		min	0	17	-5.326	17	0	17	0	17	0	17	0	17
21	P2-3A	max	0	17	67.972	17	0	17	0	17	0	17	0	17
22		min	0	17	-5.295	17	0	17	0	17	0	17	0	17
23	P1-3A	max	0	17	41.555	17	0	17	0	17	0	17	0	17
24		min	0	17	-4.696	17	0	17	0	17	0	17	0	17
25	H5	max	0	17	0	17	0	17	0	17	0	17	0	17
26		min	0	17	0	17	0	17	0	17	0	17	0	17
27	Totals:	max	0	17	80	17	0	17						
28		min	0	17	9	17	0	17						

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 15, 2010
 1:39 PM
 Checked By: *CJM*

Post-SU4 - Truck

5/11/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	18	1.307	18	0	18	0	18	0	18	0	18
2		min	0	18	-0.214	18	0	18	0	18	0	18	0	18
3	P3-3C	max	0	18	1.083	18	0	18	0	18	0	18	0	18
4		min	0	18	-6.606	18	0	18	0	18	0	18	0	18
5	P2-3C	max	0	18	53.219	18	0	18	0	18	0	18	0	18
6		min	0	18	-4.247	18	0	18	0	18	0	18	0	18
7	P1-3C	max	0	18	53.903	18	0	18	0	18	0	18	0	18
8		min	0	18	-6.684	18	0	18	0	18	0	18	0	18
9	P7-3A	max	0	18	55.731	18	0	18	0	18	0	18	0	18
10		min	0	18	-6.719	18	0	18	0	18	0	18	0	18
11	P6-3A-FTG	max	0	18	53.461	18	0	18	0	18	0	18	0	18
12		min	0	18	-6.27	18	0	18	0	18	0	18	0	18
13	P5-3A-FTG	max	0	18	54.786	18	0	18	0	18	0	18	0	18
14		min	0	18	-4.732	18	0	18	0	18	0	18	0	18
15	P4-3A-FTG	max	0	18	0	18	0	18	0	18	0	18	0	18
16		min	0	18	0	18	0	18	0	18	0	18	0	18
17	P4-3A	max	0	18	53.15	18	0	18	0	18	0	18	130.991	18
18		min	0	18	-5.453	18	0	18	0	18	0	18	-132.48	18
19	P3-3A-FTG	max	0	18	52.739	18	0	18	0	18	0	18	0	18
20		min	0	18	-5.131	18	0	18	0	18	0	18	0	18
21	P2-3A	max	0	18	52.761	18	0	18	0	18	0	18	0	18
22		min	0	18	-5	18	0	18	0	18	0	18	0	18
23	P1-3A	max	0	18	39.649	18	0	18	0	18	0	18	0	18
24		min	0	18	-4.32	18	0	18	0	18	0	18	0	18
25	H5	max	0	18	0	18	0	18	0	18	0	18	0	18
26		min	0	18	0	18	0	18	0	18	0	18	0	18
27	Totals:	max	0	18	54	18	0	18						
28		min	0	18	12	18	0	18						

Post-SU5-truck

5/11/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	19	1.49	19	0	19	0	19	0	19	0	19
2		min	0	19	-2.43	19	0	19	0	19	0	19	0	19
3	P3-3C	max	0	19	1.226	19	0	19	0	19	0	19	0	19
4		min	0	19	-7.527	19	0	19	0	19	0	19	0	19
5	P2-3C	max	0	19	60.582	19	0	19	0	19	0	19	0	19
6		min	0	19	-4.809	19	0	19	0	19	0	19	0	19
7	P1-3C	max	0	19	61.613	19	0	19	0	19	0	19	0	19
8		min	0	19	-7.76	19	0	19	0	19	0	19	0	19
9	P7-3A	max	0	19	63.032	19	0	19	0	19	0	19	0	19
10		min	0	19	-7.65	19	0	19	0	19	0	19	0	19
11	P6-3A-FTG	max	0	19	61.149	19	0	19	0	19	0	19	0	19
12		min	0	19	-6.981	19	0	19	0	19	0	19	0	19
13	P5-3A-FTG	max	0	19	61.825	19	0	19	0	19	0	19	0	19
14		min	0	19	-5.367	19	0	19	0	19	0	19	0	19
15	P4-3A-FTG	max	0	19	0	19	0	19	0	19	0	19	0	19
16		min	0	19	0	19	0	19	0	19	0	19	0	19
17	P4-3A	max	0	19	60.604	19	0	19	0	19	0	19	147.964	19
18		min	0	19	-6.161	19	0	19	0	19	0	19	-149.625	19
19	P3-3A-FTG	max	0	19	60.004	19	0	19	0	19	0	19	0	19
20		min	0	19	-5.763	19	0	19	0	19	0	19	0	19
21	P2-3A	max	0	19	59.99	19	0	19	0	19	0	19	0	19
22		min	0	19	-5.597	19	0	19	0	19	0	19	0	19
23	P1-3A	max	0	19	42.176	19	0	19	0	19	0	19	0	19
24		min	0	19	-4.861	19	0	19	0	19	0	19	0	19
25	H5	max	0	19	0	19	0	19	0	19	0	19	0	19
26		min	0	19	0	19	0	19	0	19	0	19	0	19
27	Totals:	max	0	19	62	19	0	19						
28		min	0	19	12	19	0	19						

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 15, 2010
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Post - sub-truck

S/1112

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	20	1.665	20	0	20	0	20	0	20	0	20
2		min	0	20	-27	20	0	20	0	20	0	20	0	20
3	P3-3C	max	0	20	1.367	20	0	20	0	20	0	20	0	20
4		min	0	20	-8.414	20	0	20	0	20	0	20	0	20
5	P2-3C	max	0	20	67.223	20	0	20	0	20	0	20	0	20
6		min	0	20	-5.36	20	0	20	0	20	0	20	0	20
7	P1-3C	max	0	20	68.935	20	0	20	0	20	0	20	0	20
8		min	0	20	-8.67	20	0	20	0	20	0	20	0	20
9	P7-3A	max	0	20	70.274	20	0	20	0	20	0	20	0	20
10		min	0	20	-8.545	20	0	20	0	20	0	20	0	20
11	P6-3A-FTG	max	0	20	68.452	20	0	20	0	20	0	20	0	20
12		min	0	20	-7.465	20	0	20	0	20	0	20	0	20
13	P5-3A-FTG	max	0	20	69.012	20	0	20	0	20	0	20	0	20
14		min	0	20	-5.988	20	0	20	0	20	0	20	0	20
15	P4-3A-FTG	max	0	20	0	20	0	20	0	20	0	20	0	20
16		min	0	20	0	20	0	20	0	20	0	20	0	20
17	P4-3A	max	0	20	67.755	20	0	20	0	20	0	20	164.74	20
18		min	0	20	-6.865	20	0	20	0	20	0	20	-166.729	20
19	P3-3A-FTG	max	0	20	67.049	20	0	20	0	20	0	20	0	20
20		min	0	20	-6.39	20	0	20	0	20	0	20	0	20
21	P2-3A	max	0	20	66.995	20	0	20	0	20	0	20	0	20
22		min	0	20	-6.203	20	0	20	0	20	0	20	0	20
23	P1-3A	max	0	20	46.29	20	0	20	0	20	0	20	0	20
24		min	0	20	-5.405	20	0	20	0	20	0	20	0	20
25	H5	max	0	20	0	20	0	20	0	20	0	20	0	20
26		min	0	20	0	20	0	20	0	20	0	20	0	20
27	Totals:	max	0	20	69.5	20	0	20						
28		min	0	20	8	20	0	20						

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 15, 2010
 1:41 PM
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Post-SU7 - Truck

5-11110

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	21	1.846	21	0	21	0	21	0	21	0	21
2		min	0	21	-298	21	0	21	0	21	0	21	0	21
3	P3-3C	max	0	21	1.505	21	0	21	0	21	0	21	0	21
4		min	0	21	-9.328	21	0	21	0	21	0	21	0	21
5	P2-3C	max	0	21	73.853	21	0	21	0	21	0	21	0	21
6		min	0	21	-5.903	21	0	21	0	21	0	21	0	21
7	P1-3C	max	0	21	76.564	21	0	21	0	21	0	21	0	21
8		min	0	21	-958	21	0	21	0	21	0	21	0	21
9	P7-3A	max	0	21	77.445	21	0	21	0	21	0	21	0	21
10		min	0	21	-9.464	21	0	21	0	21	0	21	0	21
11	P6-3A-FTG	max	0	21	76.111	21	0	21	0	21	0	21	0	21
12		min	0	21	-7.938	21	0	21	0	21	0	21	0	21
13	P5-3A-FTG	max	0	21	76.571	21	0	21	0	21	0	21	0	21
14		min	0	21	-6.62	21	0	21	0	21	0	21	0	21
15	P4-3A-FTG	max	0	21	0	21	0	21	0	21	0	21	0	21
16		min	0	21	0	21	0	21	0	21	0	21	0	21
17	P4-3A	max	0	21	75.136	21	0	21	0	21	0	21	180.81	21
18		min	0	21	-7.553	21	0	21	0	21	0	21	-183.704	21
19	P3-3A-FTG	max	0	21	74.3	21	0	21	0	21	0	21	0	21
20		min	0	21	-6.961	21	0	21	0	21	0	21	0	21
21	P2-3A	max	0	21	74.194	21	0	21	0	21	0	21	0	21
22		min	0	21	-6.792	21	0	21	0	21	0	21	0	21
23	P1-3A	max	0	21	50.691	21	0	21	0	21	0	21	0	21
24		min	0	21	-5.937	21	0	21	0	21	0	21	0	21
25	H5	max	0	21	0	21	0	21	0	21	0	21	0	21
26		min	0	21	0	21	0	21	0	21	0	21	0	21
27	Totals:	max	0	21	77.5	21	0	21						
28		min	0	21	8	21	0	21						

Permit - Std A - truck

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Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	22	2.3	22	0	22	0	22	0	22	0	22
2		min	0	22	-345	22	0	22	0	22	0	22	0	22
3	P3-3C	max	0	22	1.743	22	0	22	0	22	0	22	0	22
4		min	0	22	-11.623	22	0	22	0	22	0	22	0	22
5	P2-3C	max	0	22	91.483	22	0	22	0	22	0	22	0	22
6		min	0	22	-6.838	22	0	22	0	22	0	22	0	22
7	P1-3C	max	0	22	98.346	22	0	22	0	22	0	22	0	22
8		min	0	22	-1.154	22	0	22	0	22	0	22	0	22
9	P7-3A	max	0	22	92.539	22	0	22	0	22	0	22	0	22
10		min	0	22	-11.726	22	0	22	0	22	0	22	0	22
11	P6-3A-FTG	max	0	22	98.703	22	0	22	0	22	0	22	0	22
12		min	0	22	-9.035	22	0	22	0	22	0	22	0	22
13	P5-3A-FTG	max	0	22	93.585	22	0	22	0	22	0	22	0	22
14		min	0	22	-8.053	22	0	22	0	22	0	22	0	22
15	P4-3A-FTG	max	0	22	0	22	0	22	0	22	0	22	0	22
16		min	0	22	0	22	0	22	0	22	0	22	0	22
17	P4-3A	max	0	22	95.017	22	0	22	0	22	0	22	202.962	22
18		min	0	22	-8.566	22	0	22	0	22	0	22	-212.264	22
19	P3-3A-FTG	max	0	22	92.323	22	0	22	0	22	0	22	0	22
20		min	0	22	-7.472	22	0	22	0	22	0	22	0	22
21	P2-3A	max	0	22	92.186	22	0	22	0	22	0	22	0	22
22		min	0	22	-7.533	22	0	22	0	22	0	22	0	22
23	P1-3A	max	0	22	59.902	22	0	22	0	22	0	22	0	22
24		min	0	22	-6.656	22	0	22	0	22	0	22	0	22
25	H5	max	0	22	0	22	0	22	0	22	0	22	0	22
26		min	0	22	0	22	0	22	0	22	0	22	0	22
27	Totals:	max	0	22	104	22	0	22						
28		min	0	22	8	22	0	22						

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 15, 2010
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Permit - std - B-truck

5/11/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	23	2.859	23	0	23	0	23	0	23	0	23
2		min	0	23	-4.07	23	0	23	0	23	0	23	0	23
3	P3-3C	max	0	23	2.057	23	0	23	0	23	0	23	0	23
4		min	0	23	-14.446	23	0	23	0	23	0	23	0	23
5	P2-3C	max	0	23	113.69	23	0	23	0	23	0	23	0	23
6		min	0	23	-8.067	23	0	23	0	23	0	23	0	23
7	P1-3C	max	0	23	125.303	23	0	23	0	23	0	23	0	23
8		min	0	23	-1.406	23	0	23	0	23	0	23	0	23
9	P7-3A	max	0	23	114.259	23	0	23	0	23	0	23	0	23
10		min	0	23	-14.733	23	0	23	0	23	0	23	0	23
11	P6-3A-FTG	max	0	23	126.322	23	0	23	0	23	0	23	0	23
12		min	0	23	-10.74	23	0	23	0	23	0	23	0	23
13	P5-3A-FTG	max	0	23	117.851	23	0	23	0	23	0	23	0	23
14		min	0	23	-9.968	23	0	23	0	23	0	23	0	23
15	P4-3A-FTG	max	0	23	0	23	0	23	0	23	0	23	0	23
16		min	0	23	0	23	0	23	0	23	0	23	0	23
17	P4-3A	max	0	23	120.006	23	0	23	0	23	0	23	234.154	23
18		min	0	23	-9.945	23	0	23	0	23	0	23	-255.762	23
19	P3-3A-FTG	max	0	23	115.227	23	0	23	0	23	0	23	0	23
20		min	0	23	-9.004	23	0	23	0	23	0	23	0	23
21	P2-3A	max	0	23	115.317	23	0	23	0	23	0	23	0	23
22		min	0	23	-8.974	23	0	23	0	23	0	23	0	23
23	P1-3A	max	0	23	69.173	23	0	23	0	23	0	23	0	23
24		min	0	23	-7.954	23	0	23	0	23	0	23	0	23
25	H5	max	0	23	0	23	0	23	0	23	0	23	0	23
26		min	0	23	0	23	0	23	0	23	0	23	0	23
27	Totals:	max	0	23	136	23	0	23						
28		min	0	23	16	23	0	23						

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 15, 2010
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Permit-std-c-truck

5/11/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	24	3.189	24	0	24	0	24	0	24	0	24
2		min	0	24	-433	24	0	24	0	24	0	24	0	24
3	P3-3C	max	0	24	2.19	24	0	24	0	24	0	24	0	24
4		min	0	24	-16.116	24	0	24	0	24	0	24	0	24
5	P2-3C	max	0	24	126.552	24	0	24	0	24	0	24	0	24
6		min	0	24	-8.59	24	0	24	0	24	0	24	0	24
7	P1-3C	max	0	24	143.278	24	0	24	0	24	0	24	0	24
8		min	0	24	-1.545	24	0	24	0	24	0	24	0	24
9	P7-3A	max	0	24	129.183	24	0	24	0	24	0	24	0	24
10		min	0	24	-16.42	24	0	24	0	24	0	24	0	24
11	P6-3A-FTG	max	0	24	144.893	24	0	24	0	24	0	24	0	24
12		min	0	24	-11.392	24	0	24	0	24	0	24	0	24
13	P5-3A-FTG	max	0	24	132.704	24	0	24	0	24	0	24	0	24
14		min	0	24	-10.963	24	0	24	0	24	0	24	0	24
15	P4-3A-FTG	max	0	24	0	24	0	24	0	24	0	24	0	24
16		min	0	24	0	24	0	24	0	24	0	24	0	24
17	P4-3A	max	0	24	136.037	24	0	24	0	24	0	24	246.276	24
18		min	0	24	-10.475	24	0	24	0	24	0	24	-271.84	24
19	P3-3A-FTG	max	0	24	129.585	24	0	24	0	24	0	24	0	24
20		min	0	24	-9.57	24	0	24	0	24	0	24	0	24
21	P2-3A	max	0	24	129.563	24	0	24	0	24	0	24	0	24
22		min	0	24	-9.406	24	0	24	0	24	0	24	0	24
23	P1-3A	max	0	24	72.566	24	0	24	0	24	0	24	0	24
24		min	0	24	-8.341	24	0	24	0	24	0	24	0	24
25	H5	max	0	24	0	24	0	24	0	24	0	24	0	24
26		min	0	24	0	24	0	24	0	24	0	24	0	24
27	Totals:	max	0	24	159	24	0	24						
28		min	0	24	15	24	0	24						

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 15, 2010
 1:42 PM
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Permit - P411 - truck

5/11/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	25	2.644	25	0	25	0	25	0	25	0	25
2		min	0	25	-339	25	0	25	0	25	0	25	0	25
3	P3-3C	max	0	25	1.713	25	0	25	0	25	0	25	0	25
4		min	0	25	-13.362	25	0	25	0	25	0	25	0	25
5	P2-3C	max	0	25	116.702	25	0	25	0	25	0	25	0	25
6		min	0	25	-6.719	25	0	25	0	25	0	25	0	25
7	P1-3C	max	0	25	154.343	25	0	25	0	25	0	25	0	25
8		min	0	25	-1.082	25	0	25	0	25	0	25	0	25
9	P7-3A	max	0	25	128.224	25	0	25	0	25	0	25	0	25
10		min	0	25	-14.375	25	0	25	0	25	0	25	0	25
11	P6-3A-FTG	max	0	25	159.404	25	0	25	0	25	0	25	0	25
12		min	0	25	-9.796	25	0	25	0	25	0	25	0	25
13	P5-3A-FTG	max	0	25	133.597	25	0	25	0	25	0	25	0	25
14		min	0	25	-8.154	25	0	25	0	25	0	25	0	25
15	P4-3A-FTG	max	0	25	0	25	0	25	0	25	0	25	0	25
16		min	0	25	0	25	0	25	0	25	0	25	0	25
17	P4-3A	max	0	25	134.369	25	0	25	0	25	0	25	171.144	25
18		min	0	25	-7.393	25	0	25	0	25	0	25	-237.716	25
19	P3-3A-FTG	max	0	25	120.934	25	0	25	0	25	0	25	0	25
20		min	0	25	-8.546	25	0	25	0	25	0	25	0	25
21	P2-3A	max	0	25	120.04	25	0	25	0	25	0	25	0	25
22		min	0	25	-7.624	25	0	25	0	25	0	25	0	25
23	P1-3A	max	0	25	68.051	25	0	25	0	25	0	25	0	25
24		min	0	25	-6.615	25	0	25	0	25	0	25	0	25
25	H5	max	0	25	0	25	0	25	0	25	0	25	0	25
26		min	0	25	0	25	0	25	0	25	0	25	0	25
27	Totals:	max	0	25	207	25	0	25						
28		min	0	25	15	25	0	25						

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 15, 2010
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Permit- P413-truck

slit110

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	26	2.922	26	0	26	0	26	0	26	0	26
2		min	0	26	-.364	26	0	26	0	26	0	26	0	26
3	P3-3C	max	0	26	1.839	26	0	26	0	26	0	26	0	26
4		min	0	26	-14.766	26	0	26	0	26	0	26	0	26
5	P2-3C	max	0	26	115.942	26	0	26	0	26	0	26	0	26
6		min	0	26	-7.212	26	0	26	0	26	0	26	0	26
7	P1-3C	max	0	26	168.959	26	0	26	0	26	0	26	0	26
8		min	0	26	-1.021	26	0	26	0	26	0	26	0	26
9	P7-3A	max	0	26	139.084	26	0	26	0	26	0	26	0	26
10		min	0	26	-15.246	26	0	26	0	26	0	26	0	26
11	P6-3A-FTG	max	0	26	176.775	26	0	26	0	26	0	26	0	26
12		min	0	26	-9.983	26	0	26	0	26	0	26	0	26
13	P5-3A-FTG	max	0	26	143.344	26	0	26	0	26	0	26	0	26
14		min	0	26	-8.593	26	0	26	0	26	0	26	0	26
15	P4-3A-FTG	max	0	26	0	26	0	26	0	26	0	26	0	26
16		min	0	26	0	26	0	26	0	26	0	26	0	26
17	P4-3A	max	0	26	138.425	26	0	26	0	26	0	26	189.014	26
18		min	0	26	-8.493	26	0	26	0	26	0	26	-245.634	26
19	P3-3A-FTG	max	0	26	125.425	26	0	26	0	26	0	26	0	26
20		min	0	26	-8.647	26	0	26	0	26	0	26	0	26
21	P2-3A	max	0	26	122.065	26	0	26	0	26	0	26	0	26
22		min	0	26	-7.689	26	0	26	0	26	0	26	0	26
23	P1-3A	max	0	26	72.558	26	0	26	0	26	0	26	0	26
24		min	0	26	-7.007	26	0	26	0	26	0	26	0	26
25	H5	max	0	26	0	26	0	26	0	26	0	26	0	26
26		min	0	26	0	26	0	26	0	26	0	26	0	26
27	Totals:	max	0	26	255	26	0	26						
28		min	0	26	15	26	0	26						

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 15, 2010
 1:43 PM
 Checked By: CJL

Permit - std - C152B

5/11/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	27	3.122	27	0	27	0	27	0	27	0	27
2		min	0	27	-434	27	0	27	0	27	0	27	0	27
3	P3-3C	max	0	27	2.193	27	0	27	0	27	0	27	0	27
4		min	0	27	-15.774	27	0	27	0	27	0	27	0	27
5	P2-3C	max	0	27	123.945	27	0	27	0	27	0	27	0	27
6		min	0	27	-8.602	27	0	27	0	27	0	27	0	27
7	P1-3C	max	0	27	138.537	27	0	27	0	27	0	27	0	27
8		min	0	27	-1.523	27	0	27	0	27	0	27	0	27
9	P7-3A	max	0	27	126.362	27	0	27	0	27	0	27	0	27
10		min	0	27	-16.073	27	0	27	0	27	0	27	0	27
11	P6-3A-FTG	max	0	27	139.884	27	0	27	0	27	0	27	0	27
12		min	0	27	-11.376	27	0	27	0	27	0	27	0	27
13	P5-3A-FTG	max	0	27	128.513	27	0	27	0	27	0	27	0	27
14		min	0	27	-10.789	27	0	27	0	27	0	27	0	27
15	P4-3A-FTG	max	0	27	0	27	0	27	0	27	0	27	0	27
16		min	0	27	0	27	0	27	0	27	0	27	0	27
17	P4-3A	max	0	27	131.941	27	0	27	0	27	0	27	248.211	27
18		min	0	27	-10.542	27	0	27	0	27	0	27	-271.632	27
19	P3-3A-FTG	max	0	27	126.089	27	0	27	0	27	0	27	0	27
20		min	0	27	-9.562	27	0	27	0	27	0	27	0	27
21	P2-3A	max	0	27	126.03	27	0	27	0	27	0	27	0	27
22		min	0	27	-9.448	27	0	27	0	27	0	27	0	27
23	P1-3A	max	0	27	71.543	27	0	27	0	27	0	27	0	27
24		min	0	27	-8.378	27	0	27	0	27	0	27	0	27
25	H5	max	0	27	0	27	0	27	0	27	0	27	0	27
26		min	0	27	0	27	0	27	0	27	0	27	0	27
27	Totals:	max	0	27	152.2	27	0	27						
28		min	0	27	16	27	0	27						

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 15, 2010
 1:43 PM
 Checked By: *CJM*

Permit-Std - C174 B

5/11/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	28	3.27	28	0	28	0	28	0	28	0	28
2		min	0	28	-4.23	28	0	28	0	28	0	28	0	28
3	P3-3C	max	0	28	2.139	28	0	28	0	28	0	28	0	28
4		min	0	28	-16.522	28	0	28	0	28	0	28	0	28
5	P2-3C	max	0	28	129.286	28	0	28	0	28	0	28	0	28
6		min	0	28	-8.388	28	0	28	0	28	0	28	0	28
7	P1-3C	max	0	28	152.527	28	0	28	0	28	0	28	0	28
8		min	0	28	-1.558	28	0	28	0	28	0	28	0	28
9	P7-3A	max	0	28	136.206	28	0	28	0	28	0	28	0	28
10		min	0	28	-16.826	28	0	28	0	28	0	28	0	28
11	P6-3A-FTG	max	0	28	154.784	28	0	28	0	28	0	28	0	28
12		min	0	28	-11.108	28	0	28	0	28	0	28	0	28
13	P5-3A-FTG	max	0	28	138.574	28	0	28	0	28	0	28	0	28
14		min	0	28	-11.011	28	0	28	0	28	0	28	0	28
15	P4-3A-FTG	max	0	28	0	28	0	28	0	28	0	28	0	28
16		min	0	28	0	28	0	28	0	28	0	28	0	28
17	P4-3A	max	0	28	143.186	28	0	28	0	28	0	28	234.298	28
18		min	0	28	-10.004	28	0	28	0	28	0	28	-260.477	28
19	P3-3A-FTG	max	0	28	135.512	28	0	28	0	28	0	28	0	28
20		min	0	28	-9.17	28	0	28	0	28	0	28	0	28
21	P2-3A	max	0	28	134.979	28	0	28	0	28	0	28	0	28
22		min	0	28	-8.925	28	0	28	0	28	0	28	0	28
23	P1-3A	max	0	28	70.121	28	0	28	0	28	0	28	0	28
24		min	0	28	-7.879	28	0	28	0	28	0	28	0	28
25	H5	max	0	28	0	28	0	28	0	28	0	28	0	28
26		min	0	28	0	28	0	28	0	28	0	28	0	28
27	Totals:	max	0	28	174	28	0	28						
28		min	0	28	14	28	0	28						

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 15, 2010
 1:43 PM
 Checked By: CJM

Permit - std - C198-23

5/11/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	29	3.113	29	0	29	0	29	0	29	0	29
2		min	0	29	-3.75	29	0	29	0	29	0	29	0	29
3	P3-3C	max	0	29	1.892	29	0	29	0	29	0	29	0	29
4		min	0	29	-15.728	29	0	29	0	29	0	29	0	29
5	P2-3C	max	0	29	128.011	29	0	29	0	29	0	29	0	29
6		min	0	29	-7.422	29	0	29	0	29	0	29	0	29
7	P1-3C	max	0	29	161.572	29	0	29	0	29	0	29	0	29
8		min	0	29	-1.397	29	0	29	0	29	0	29	0	29
9	P7-3A	max	0	29	140.278	29	0	29	0	29	0	29	0	29
10		min	0	29	-16.276	29	0	29	0	29	0	29	0	29
11	P6-3A-FTG	max	0	29	165.503	29	0	29	0	29	0	29	0	29
12		min	0	29	-10.424	29	0	29	0	29	0	29	0	29
13	P5-3A-FTG	max	0	29	142.885	29	0	29	0	29	0	29	0	29
14		min	0	29	-9.897	29	0	29	0	29	0	29	0	29
15	P4-3A-FTG	max	0	29	0	29	0	29	0	29	0	29	0	29
16		min	0	29	0	29	0	29	0	29	0	29	0	29
17	P4-3A	max	0	29	147.224	29	0	29	0	29	0	29	194.212	29
18		min	0	29	-8.336	29	0	29	0	29	0	29	-239.443	29
19	P3-3A-FTG	max	0	29	136.638	29	0	29	0	29	0	29	0	29
20		min	0	29	-8.429	29	0	29	0	29	0	29	0	29
21	P2-3A	max	0	29	135.36	29	0	29	0	29	0	29	0	29
22		min	0	29	-7.892	29	0	29	0	29	0	29	0	29
23	P1-3A	max	0	29	67.325	29	0	29	0	29	0	29	0	29
24		min	0	29	-6.811	29	0	29	0	29	0	29	0	29
25	H5	max	0	29	0	29	0	29	0	29	0	29	0	29
26		min	0	29	0	29	0	29	0	29	0	29	0	29
27	Totals:	max	0	29	198	29	0	29						
28		min	0	29	14	29	0	29						

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 15, 2010
 1:44 PM
 Checked By: *CTM*

Permit - std - C214B

shille

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	30	3.035	30	0	30	0	30	0	30	0	30
2		min	0	30	-3.363	30	0	30	0	30	0	30	0	30
3	P3-3C	max	0	30	1.835	30	0	30	0	30	0	30	0	30
4		min	0	30	-15.335	30	0	30	0	30	0	30	0	30
5	P2-3C	max	0	30	124.228	30	0	30	0	30	0	30	0	30
6		min	0	30	-7.196	30	0	30	0	30	0	30	0	30
7	P1-3C	max	0	30	167.742	30	0	30	0	30	0	30	0	30
8		min	0	30	-1.324	30	0	30	0	30	0	30	0	30
9	P7-3A	max	0	30	143.593	30	0	30	0	30	0	30	0	30
10		min	0	30	-15.869	30	0	30	0	30	0	30	0	30
11	P6-3A-FTG	max	0	30	172.679	30	0	30	0	30	0	30	0	30
12		min	0	30	-9.911	30	0	30	0	30	0	30	0	30
13	P5-3A-FTG	max	0	30	147.183	30	0	30	0	30	0	30	0	30
14		min	0	30	-9.162	30	0	30	0	30	0	30	0	30
15	P4-3A-FTG	max	0	30	0	30	0	30	0	30	0	30	0	30
16		min	0	30	0	30	0	30	0	30	0	30	0	30
17	P4-3A	max	0	30	150.221	30	0	30	0	30	0	30	185.905	30
18		min	0	30	-8.042	30	0	30	0	30	0	30	-239.913	30
19	P3-3A-FTG	max	0	30	137.814	30	0	30	0	30	0	30	0	30
20		min	0	30	-8.546	30	0	30	0	30	0	30	0	30
21	P2-3A	max	0	30	136.256	30	0	30	0	30	0	30	0	30
22		min	0	30	-7.555	30	0	30	0	30	0	30	0	30
23	P1-3A	max	0	30	71.762	30	0	30	0	30	0	30	0	30
24		min	0	30	-6.52	30	0	30	0	30	0	30	0	30
25	H5	max	0	30	0	30	0	30	0	30	0	30	0	30
26		min	0	30	0	30	0	30	0	30	0	30	0	30
27	Totals:	max	0	30	214	30	0	30						
28		min	0	30	14	30	0	30						

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 15, 2010
 1:44 PM
 Checked By: *Gu*

Permit - Std - C237B

5/11/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	31	2.807	31	0	31	0	31	0	31	0	31
2		min	0	31	-366	31	0	31	0	31	0	31	0	31
3	P3-3C	max	0	31	1.851	31	0	31	0	31	0	31	0	31
4		min	0	31	-14.184	31	0	31	0	31	0	31	0	31
5	P2-3C	max	0	31	117.762	31	0	31	0	31	0	31	0	31
6		min	0	31	-7.26	31	0	31	0	31	0	31	0	31
7	P1-3C	max	0	31	167.622	31	0	31	0	31	0	31	0	31
8		min	0	31	-1.095	31	0	31	0	31	0	31	0	31
9	P7-3A	max	0	31	139.249	31	0	31	0	31	0	31	0	31
10		min	0	31	-15.15	31	0	31	0	31	0	31	0	31
11	P6-3A-FTG	max	0	31	174.399	31	0	31	0	31	0	31	0	31
12		min	0	31	-9.872	31	0	31	0	31	0	31	0	31
13	P5-3A-FTG	max	0	31	143.226	31	0	31	0	31	0	31	0	31
14		min	0	31	-8.326	31	0	31	0	31	0	31	0	31
15	P4-3A-FTG	max	0	31	0	31	0	31	0	31	0	31	0	31
16		min	0	31	0	31	0	31	0	31	0	31	0	31
17	P4-3A	max	0	31	142.248	31	0	31	0	31	0	31	185.766	31
18		min	0	31	-8.22	31	0	31	0	31	0	31	-243.425	31
19	P3-3A-FTG	max	0	31	127.52	31	0	31	0	31	0	31	0	31
20		min	0	31	-8.948	31	0	31	0	31	0	31	0	31
21	P2-3A	max	0	31	125.263	31	0	31	0	31	0	31	0	31
22		min	0	31	-7.514	31	0	31	0	31	0	31	0	31
23	P1-3A	max	0	31	70.982	31	0	31	0	31	0	31	0	31
24		min	0	31	-6.735	31	0	31	0	31	0	31	0	31
25	H5	max	0	31	0	31	0	31	0	31	0	31	0	31
26		min	0	31	0	31	0	31	0	31	0	31	0	31
27	Totals:	max	0	31	237.4	31	0	31						
28		min	0	31	13	31	0	31						

Permit-std- C 256B

amlio

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	32	2.967	32	0	32	0	32	0	32	0	32
2		min	0	32	-3.73	32	0	32	0	32	0	32	0	32
3	P3-3C	max	0	32	1.884	32	0	32	0	32	0	32	0	32
4		min	0	32	-14.994	32	0	32	0	32	0	32	0	32
5	P2-3C	max	0	32	116.871	32	0	32	0	32	0	32	0	32
6		min	0	32	-7.389	32	0	32	0	32	0	32	0	32
7	P1-3C	max	0	32	168.716	32	0	32	0	32	0	32	0	32
8		min	0	32	-1.027	32	0	32	0	32	0	32	0	32
9	P7-3A	max	0	32	137.972	32	0	32	0	32	0	32	0	32
10		min	0	32	-15.278	32	0	32	0	32	0	32	0	32
11	P6-3A-FTG	max	0	32	176.424	32	0	32	0	32	0	32	0	32
12		min	0	32	-9.941	32	0	32	0	32	0	32	0	32
13	P5-3A-FTG	max	0	32	142.832	32	0	32	0	32	0	32	0	32
14		min	0	32	-8.771	32	0	32	0	32	0	32	0	32
15	P4-3A-FTG	max	0	32	0	32	0	32	0	32	0	32	0	32
16		min	0	32	0	32	0	32	0	32	0	32	0	32
17	P4-3A	max	0	32	137.528	32	0	32	0	32	0	32	195.191	32
18		min	0	32	-8.748	32	0	32	0	32	0	32	-249.587	32
19	P3-3A-FTG	max	0	32	124.479	32	0	32	0	32	0	32	0	32
20		min	0	32	-8.969	32	0	32	0	32	0	32	0	32
21	P2-3A	max	0	32	121.693	32	0	32	0	32	0	32	0	32
22		min	0	32	-7.801	32	0	32	0	32	0	32	0	32
23	P1-3A	max	0	32	73.624	32	0	32	0	32	0	32	0	32
24		min	0	32	-7.154	32	0	32	0	32	0	32	0	32
25	H5	max	0	32	0	32	0	32	0	32	0	32	0	32
26		min	0	32	0	32	0	32	0	32	0	32	0	32
27	Totals:	max	0	32	256	32	0	32						
28		min	0	32	16	32	0	32						

Longer truck will
 control. (This is the
 short truck)

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Apr 15, 2010
 1:45 PM
 Checked By: *CTH*

Permit-std - C200j

5/11/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	33	3.361	33	0	33	0	33	0	33	0	33
2		min	0	33	-4.23	33	0	33	0	33	0	33	0	33
3	P3-3C	max	0	33	2.139	33	0	33	0	33	0	33	0	33
4		min	0	33	-16.982	33	0	33	0	33	0	33	0	33
5	P2-3C	max	0	33	128.179	33	0	33	0	33	0	33	0	33
6		min	0	33	-8.39	33	0	33	0	33	0	33	0	33
7	P1-3C	max	0	33	169.351	33	0	33	0	33	0	33	0	33
8		min	0	33	-1.55	33	0	33	0	33	0	33	0	33
9	P7-3A	max	0	33	154.822	33	0	33	0	33	0	33	0	33
10		min	0	33	-16.722	33	0	33	0	33	0	33	0	33
11	P6-3A-FTG	max	0	33	172.317	33	0	33	0	33	0	33	0	33
12		min	0	33	-8.914	33	0	33	0	33	0	33	0	33
13	P5-3A-FTG	max	0	33	151.932	33	0	33	0	33	0	33	0	33
14		min	0	33	-10.472	33	0	33	0	33	0	33	0	33
15	P4-3A-FTG	max	0	33	0	33	0	33	0	33	0	33	0	33
16		min	0	33	0	33	0	33	0	33	0	33	0	33
17	P4-3A	max	0	33	156.939	33	0	33	0	33	0	33	222.289	33
18		min	0	33	-9.325	33	0	33	0	33	0	33	-246.852	33
19	P3-3A-FTG	max	0	33	149.087	33	0	33	0	33	0	33	0	33
20		min	0	33	-8.646	33	0	33	0	33	0	33	0	33
21	P2-3A	max	0	33	146.477	33	0	33	0	33	0	33	0	33
22		min	0	33	-7.337	33	0	33	0	33	0	33	0	33
23	P1-3A	max	0	33	74.235	33	0	33	0	33	0	33	0	33
24		min	0	33	-6.685	33	0	33	0	33	0	33	0	33
25	H5	max	0	33	0	33	0	33	0	33	0	33	0	33
26		min	0	33	0	33	0	33	0	33	0	33	0	33
27	Totals:	max	0	33	200	33	0	33						
28		min	0	33	20	33	0	33						

5/12/10

Joint Reactions (By Item)

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
305	34	P4-3A	0	47.272	0	0	0	-10.91
306	35		0	69.297	0	0	0	2.427
307	36		0	70.83	0	0	0	-8.928
308	37		0	0	0	0	0	0
309	38		0	0	0	0	0	0
310	39		0	0	0	0	0	0
311	40		0	75.145	0	0	0	-8.887
312	41		0	95.181	0	0	0	-16.359
313	42		0	120.006	0	0	0	1.004
314	43		0	136.045	0	0	0	-4.183
315	44		0	134.377	0	0	0	37.179
316	45		0	138.424	0	0	0	35.424
317	46		0	131.944	0	0	0	-5.717
318	47		0	143.195	0	0	0	-9.344
319	48		0	147.224	0	0	0	1.322
320	49		0	150.223	0	0	0	9.092
321	50		0	142.248	0	0	0	30.88
322	51		0	137.528	0	0	0	48.657
323	52		0	157.146	0	0	0	-19.632
324	53		0	36.6	0	0	0	-118.355
325	54		0	50.363	0	0	0	-143.541
326	55		0	52.488	0	0	0	-153.551
327	56		0	0	0	0	0	0
328	57		0	0	0	0	0	0
329	58		0	0	0	0	0	0
330	59		0	57.671	0	0	0	-185.192
331	60		0	71.692	0	0	0	-216.174
332	61		0	87.928	0	0	0	-256.294
333	62		0	96.42	0	0	0	-273.385
334	63		0	80.132	0	0	0	-237.723
335	64		0	88.348	0	0	0	-245.688
336	65		0	95.562	0	0	0	-273.42
337	66		0	96.276	0	0	0	-267.169
338	67		0	84.588	0	0	0	-239.447
339	68		0	82.286	0	0	0	-239.921
340	69		0	85.216	0	0	0	-243.426
341	70		0	87.459	0	0	0	-251.818
342	71		0	98.109	0	0	0	-265.927

See Load Combinations Spreadsheet
 at beginning of this section for
 LC descriptions.

Permit - std - C152B - Long

stillio

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	72	2.772	72	0	72	0	72	0	72	0	72
2		min	0	72	-3.44	72	0	72	0	72	0	72	0	72
3	P3-3C	max	0	72	1.738	72	0	72	0	72	0	72	0	72
4		min	0	72	-14.008	72	0	72	0	72	0	72	0	72
5	P2-3C	max	0	72	113.195	72	0	72	0	72	0	72	0	72
6		min	0	72	-6.816	72	0	72	0	72	0	72	0	72
7	P1-3C	max	0	72	130.657	72	0	72	0	72	0	72	0	72
8		min	0	72	-1.3	72	0	72	0	72	0	72	0	72
9	P7-3A	max	0	72	118.546	72	0	72	0	72	0	72	0	72
10		min	0	72	-14.385	72	0	72	0	72	0	72	0	72
11	P6-3A-FTG	max	0	72	133.051	72	0	72	0	72	0	72	0	72
12		min	0	72	-10.581	72	0	72	0	72	0	72	0	72
13	P5-3A-FTG	max	0	72	118.743	72	0	72	0	72	0	72	0	72
14		min	0	72	-9.273	72	0	72	0	72	0	72	0	72
15	P4-3A-FTG	max	0	72	0	72	0	72	0	72	0	72	0	72
16		min	0	72	0	72	0	72	0	72	0	72	0	72
17	P4-3A	max	0	72	121.601	72	0	72	0	72	0	72	193.908	72
18		min	0	72	-8.207	72	0	72	0	72	0	72	-214.911	72
19	P3-3A-FTG	max	0	72	113.836	72	0	72	0	72	0	72	0	72
20		min	0	72	-7.573	72	0	72	0	72	0	72	0	72
21	P2-3A	max	0	72	113.587	72	0	72	0	72	0	72	0	72
22		min	0	72	-7.569	72	0	72	0	72	0	72	0	72
23	P1-3A	max	0	72	67.276	72	0	72	0	72	0	72	0	72
24		min	0	72	-6.561	72	0	72	0	72	0	72	0	72
25	H5	max	0	72	0	72	0	72	0	72	0	72	0	72
26		min	0	72	0	72	0	72	0	72	0	72	0	72
27	Totals:	max	0	72	152.2	72	0	72						
28		min	0	72	16	72	0	72						

Longer truck does not control

Permit-Std-C174B-Long

5/11/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	73	2.848	73	0	73	0	73	0	73	0	73
2		min	0	73	-35	73	0	73	0	73	0	73	0	73
3	P3-3C	max	0	73	1.771	73	0	73	0	73	0	73	0	73
4		min	0	73	-14.391	73	0	73	0	73	0	73	0	73
5	P2-3C	max	0	73	116.535	73	0	73	0	73	0	73	0	73
6		min	0	73	-6.945	73	0	73	0	73	0	73	0	73
7	P1-3C	max	0	73	143.168	73	0	73	0	73	0	73	0	73
8		min	0	73	-1.289	73	0	73	0	73	0	73	0	73
9	P7-3A	max	0	73	127.661	73	0	73	0	73	0	73	0	73
10		min	0	73	-14.809	73	0	73	0	73	0	73	0	73
11	P6-3A-FTG	max	0	73	146.512	73	0	73	0	73	0	73	0	73
12		min	0	73	-10.313	73	0	73	0	73	0	73	0	73
13	P5-3A-FTG	max	0	73	127.857	73	0	73	0	73	0	73	0	73
14		min	0	73	-9.166	73	0	73	0	73	0	73	0	73
15	P4-3A-FTG	max	0	73	0	73	0	73	0	73	0	73	0	73
16		min	0	73	0	73	0	73	0	73	0	73	0	73
17	P4-3A	max	0	73	130.873	73	0	73	0	73	0	73	187.655	73
18		min	0	73	-7.907	73	0	73	0	73	0	73	-219.774	73
19	P3-3A-FTG	max	0	73	121.406	73	0	73	0	73	0	73	0	73
20		min	0	73	-8.109	73	0	73	0	73	0	73	0	73
21	P2-3A	max	0	73	120.625	73	0	73	0	73	0	73	0	73
22		min	0	73	-7.415	73	0	73	0	73	0	73	0	73
23	P1-3A	max	0	73	70.079	73	0	73	0	73	0	73	0	73
24		min	0	73	-6.326	73	0	73	0	73	0	73	0	73
25	H5	max	0	73	0	73	0	73	0	73	0	73	0	73
26		min	0	73	0	73	0	73	0	73	0	73	0	73
27	Totals:	max	0	73	174	73	0	73						
28		min	0	73	14	73	0	73						

Longer truck does not control

Permit - std - C198-23 - Long

5/11/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	74	2.694	74	0	74	0	74	0	74	0	74
2		min	0	74	-3.358	74	0	74	0	74	0	74	0	74
3	P3-3C	max	0	74	1.811	74	0	74	0	74	0	74	0	74
4		min	0	74	-13.611	74	0	74	0	74	0	74	0	74
5	P2-3C	max	0	74	114.361	74	0	74	0	74	0	74	0	74
6		min	0	74	-7.102	74	0	74	0	74	0	74	0	74
7	P1-3C	max	0	74	150.017	74	0	74	0	74	0	74	0	74
8		min	0	74	-1.151	74	0	74	0	74	0	74	0	74
9	P7-3A	max	0	74	130.735	74	0	74	0	74	0	74	0	74
10		min	0	74	-14.015	74	0	74	0	74	0	74	0	74
11	P6-3A-FTG	max	0	74	155.007	74	0	74	0	74	0	74	0	74
12		min	0	74	-9.76	74	0	74	0	74	0	74	0	74
13	P5-3A-FTG	max	0	74	130.944	74	0	74	0	74	0	74	0	74
14		min	0	74	-7.983	74	0	74	0	74	0	74	0	74
15	P4-3A-FTG	max	0	74	0	74	0	74	0	74	0	74	0	74
16		min	0	74	0	74	0	74	0	74	0	74	0	74
17	P4-3A	max	0	74	131.912	74	0	74	0	74	0	74	182.429	74
18		min	0	74	-7.842	74	0	74	0	74	0	74	-226.183	74
19	P3-3A-FTG	max	0	74	119.979	74	0	74	0	74	0	74	0	74
20		min	0	74	-8.452	74	0	74	0	74	0	74	0	74
21	P2-3A	max	0	74	118.387	74	0	74	0	74	0	74	0	74
22		min	0	74	-7.19	74	0	74	0	74	0	74	0	74
23	P1-3A	max	0	74	71.961	74	0	74	0	74	0	74	0	74
24		min	0	74	-6.227	74	0	74	0	74	0	74	0	74
25	H5	max	0	74	0	74	0	74	0	74	0	74	0	74
26		min	0	74	0	74	0	74	0	74	0	74	0	74
27	Totals:	max	0	74	198	74	0	74						
28		min	0	74	14	74	0	74						

Longer truck does not control

Permit - std - C214 B - Long

studio

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	75	2.62	75	0	75	0	75	0	75	0	75
2		min	0	75	-3.68	75	0	75	0	75	0	75	0	75
3	P3-3C	max	0	75	1.858	75	0	75	0	75	0	75	0	75
4		min	0	75	-13.24	75	0	75	0	75	0	75	0	75
5	P2-3C	max	0	75	112.201	75	0	75	0	75	0	75	0	75
6		min	0	75	-7.286	75	0	75	0	75	0	75	0	75
7	P1-3C	max	0	75	154.831	75	0	75	0	75	0	75	0	75
8		min	0	75	-1.107	75	0	75	0	75	0	75	0	75
9	P7-3A	max	0	75	134.196	75	0	75	0	75	0	75	0	75
10		min	0	75	-14.095	75	0	75	0	75	0	75	0	75
11	P6-3A-FTG	max	0	75	160.717	75	0	75	0	75	0	75	0	75
12		min	0	75	-9.382	75	0	75	0	75	0	75	0	75
13	P5-3A-FTG	max	0	75	134.445	75	0	75	0	75	0	75	0	75
14		min	0	75	-7.721	75	0	75	0	75	0	75	0	75
15	P4-3A-FTG	max	0	75	0	75	0	75	0	75	0	75	0	75
16		min	0	75	0	75	0	75	0	75	0	75	0	75
17	P4-3A	max	0	75	132.897	75	0	75	0	75	0	75	187.254	75
18		min	0	75	-8.188	75	0	75	0	75	0	75	-232.524	75
19	P3-3A-FTG	max	0	75	119.69	75	0	75	0	75	0	75	0	75
20		min	0	75	-8.602	75	0	75	0	75	0	75	0	75
21	P2-3A	max	0	75	117.991	75	0	75	0	75	0	75	0	75
22		min	0	75	-7.248	75	0	75	0	75	0	75	0	75
23	P1-3A	max	0	75	73.998	75	0	75	0	75	0	75	0	75
24		min	0	75	-6.432	75	0	75	0	75	0	75	0	75
25	H5	max	0	75	0	75	0	75	0	75	0	75	0	75
26		min	0	75	0	75	0	75	0	75	0	75	0	75
27	Totals:	max	0	75	214	75	0	75						
28		min	0	75	14	75	0	75						

Longer truck does not control

Permit- std- C237B-Long

stillis

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	76	2.807	76	0	76	0	76	0	76	0	76
2		min	0	76	-3.384	76	0	76	0	76	0	76	0	76
3	P3-3C	max	0	76	1.938	76	0	76	0	76	0	76	0	76
4		min	0	76	-14.184	76	0	76	0	76	0	76	0	76
5	P2-3C	max	0	76	111.205	76	0	76	0	76	0	76	0	76
6		min	0	76	-7.602	76	0	76	0	76	0	76	0	76
7	P1-3C	max	0	76	144.75	76	0	76	0	76	0	76	0	76
8		min	0	76	-1.053	76	0	76	0	76	0	76	0	76
9	P7-3A	max	0	76	123.948	76	0	76	0	76	0	76	0	76
10		min	0	76	-14.339	76	0	76	0	76	0	76	0	76
11	P6-3A-FTG	max	0	76	152.161	76	0	76	0	76	0	76	0	76
12		min	0	76	-9.686	76	0	76	0	76	0	76	0	76
13	P5-3A-FTG	max	0	76	123.908	76	0	76	0	76	0	76	0	76
14		min	0	76	-8.668	76	0	76	0	76	0	76	0	76
15	P4-3A-FTG	max	0	76	0	76	0	76	0	76	0	76	0	76
16		min	0	76	0	76	0	76	0	76	0	76	0	76
17	P4-3A	max	0	76	116.692	76	0	76	0	76	0	76	213.829	76
18		min	0	76	-9.481	76	0	76	0	76	0	76	-242.093	76
19	P3-3A-FTG	max	0	76	107.197	76	0	76	0	76	0	76	0	76
20		min	0	76	-8.948	76	0	76	0	76	0	76	0	76
21	P2-3A	max	0	76	112.783	76	0	76	0	76	0	76	0	76
22		min	0	76	-7.968	76	0	76	0	76	0	76	0	76
23	P1-3A	max	0	76	74.637	76	0	76	0	76	0	76	0	76
24		min	0	76	-7.336	76	0	76	0	76	0	76	0	76
25	H5	max	0	76	0	76	0	76	0	76	0	76	0	76
26		min	0	76	0	76	0	76	0	76	0	76	0	76
27	Totals:	max	0	76	237.4	76	0	76						
28		min	0	76	13	76	0	76						

Longer truck does not control

Permit - Std - C256B - Long

5/11/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	77	2.967	77	0	77	0	77	0	77	0	77
2		min	0	77	-3.99	77	0	77	0	77	0	77	0	77
3	P3-3C	max	0	77	2.017	77	0	77	0	77	0	77	0	77
4		min	0	77	-14.994	77	0	77	0	77	0	77	0	77
5	P2-3C	max	0	77	116.871	77	0	77	0	77	0	77	0	77
6		min	0	77	-7.91	77	0	77	0	77	0	77	0	77
7	P1-3C	max	0	77	144.33	77	0	77	0	77	0	77	0	77
8		min	0	77	-1.122	77	0	77	0	77	0	77	0	77
9	P7-3A	max	0	77	124.479	77	0	77	0	77	0	77	0	77
10		min	0	77	-15.18	77	0	77	0	77	0	77	0	77
11	P6-3A-FTG	max	0	77	151.752	77	0	77	0	77	0	77	0	77
12		min	0	77	-10.031	77	0	77	0	77	0	77	0	77
13	P5-3A-FTG	max	0	77	124.062	77	0	77	0	77	0	77	0	77
14		min	0	77	-9.38	77	0	77	0	77	0	77	0	77
15	P4-3A-FTG	max	0	77	0	77	0	77	0	77	0	77	0	77
16		min	0	77	0	77	0	77	0	77	0	77	0	77
17	P4-3A	max	0	77	122.209	77	0	77	0	77	0	77	229.815	77
18		min	0	77	-9.963	77	0	77	0	77	0	77	-251.803	77
19	P3-3A-FTG	max	0	77	111.267	77	0	77	0	77	0	77	0	77
20		min	0	77	-8.969	77	0	77	0	77	0	77	0	77
21	P2-3A	max	0	77	119.434	77	0	77	0	77	0	77	0	77
22		min	0	77	-8.497	77	0	77	0	77	0	77	0	77
23	P1-3A	max	0	77	73.99	77	0	77	0	77	0	77	0	77
24		min	0	77	-7.853	77	0	77	0	77	0	77	0	77
25	H5	max	0	77	0	77	0	77	0	77	0	77	0	77
26		min	0	77	0	77	0	77	0	77	0	77	0	77
27	Totals:	max	0	77	256	77	0	77						
28		min	0	77	16	77	0	77						

Longer truck controls

The variable axle spacing of 50' was also checked, but this produced more torsion (51' axle spacing).

-251.657
 -1 -251.789
 -1 -251.773
 +.73 -251.72
 +.50 -251.818 ✓



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PROJECT MnDOT SS-69801J-3A.P4. Posting + Permit Trucks - Shear
PROJECT # 090147 DATE 4/15/10 BY jdf SHEET NO. OF

When applying a truck, the left position causes higher stresses than the right

^{maximum}
The Forces from the trucks separate are the same as one truck located left or Right.

One Lane left w/ multiple presence factor of 1.2 causes larger forces between Beams A & B, but two lanes left w/o multiple presence factor causes a larger force between Beams B & D

We will model 2 trucks left and 1 truck left with max Reaction and max torsion.

Reviewing the Results:

- The Maximum Torque w/ accompanying Reaction always controls.
- Posting trucks - Controlled by 2 lanes of vehicles & Multiple Presence Factor of 1.0
- Permit trucks - Controlled by 1 lane of traffic w/ multiple presence factor of 1.2
- The R/F's for escorted, single lane trucks were lower than for multiple lanes of traffic due to multiple presence factor of 1.2 for single lane. This will control single trip permits.

Member Section Forces (By Item)

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Moment[k-...	z-z Moment[k-...
1	10	M1	1	-2.779	-76.901	5.074	23.855	1.336	0
2			2	5.937	12.358	-4.767	-18.073	-1.012	0
3	11	M1	1	-3.785	-79.134	6.357	27.979	1.567	0
4			2	6.778	17.991	-5.973	-19.81	-1.109	0
5	12	M1	1	-3.919	-79.431	6.357	27.98	1.567	0
6			2	6.907	18.389	-5.973	-21.456	-1.202	0
7	13	M1	1	-4.226	-98.978	7.349	37.501	2.1	0
8			2	8.113	19.556	-6.904	-24.437	-1.369	0
9	14	M1	1	-4.402	-122.733	8.632	28.599	1.602	0
10			2	9.447	19.641	-8.11	-28.312	-1.586	0
11	15	M1	1	-4.474	-137.99	9.565	34.295	1.921	0
12			2	10.262	19.694	-8.987	-31.13	-1.743	0
13	16	M1	1	-4.475	-136.432	11.548	68.675	3.846	0
14			2	10.188	19.689	-10.85	-37.12	-2.079	0
15	17	M1	1	-4.509	-140.309	13.472	73.375	4.109	0
16			2	10.41	19.703	-12.658	-42.932	-2.404	0
17	18	M1	1	-4.443	-134.062	9.332	34.846	1.952	0
18			2	10.039	19.679	-8.767	-30.426	-1.704	0
19	19	M1	1	-4.511	-144.814	10.206	40.739	2.282	0
20			2	10.632	19.717	-9.589	-33.068	-1.852	0
21	20	M1	1	-4.546	-148.674	11.139	36.927	2.068	0
22			2	10.854	19.732	-10.466	-35.886	-2.01	0
23	21	M1	1	-4.555	-151.519	11.781	45.589	2.553	0
24			2	11.002	19.741	-11.069	-37.824	-2.118	0
25	22	M1	1	-4.551	-143.999	12.773	67.261	3.767	0
26			2	10.632	19.717	-12	-40.818	-2.286	0
27	23	M1	1	-4.479	-139.396	13.531	84.783	4.748	0
28			2	10.336	19.698	-12.713	-43.109	-2.414	0
29	24	M1	1	-4.603	-158.14	11.256	52.838	2.959	0
30			2	11.373	19.765	-10.576	-36.239	-2.029	0
31	25	M1	1	-2.163	-59.099	5.074	173.454	9.714	0
32			2	4.587	9.566	-4.767	-45.193	-2.531	0
33	26	M1	1	-2.767	-60.438	6.357	177.579	9.945	0
34			2	5.085	13.084	-5.973	-55.415	-3.103	0
35	27	M1	1	-2.901	-60.736	6.357	177.579	9.945	0
36			2	5.207	13.629	-5.973	-57.938	-3.245	0
37	28	M1	1	-3.257	-74.724	7.349	207.059	11.596	0
38			2	6.18	15.009	-6.904	-68.927	-3.86	0
39	29	M1	1	-3.321	-90.135	8.632	245.217	13.733	0
40			2	6.995	15.061	-8.11	-72.803	-4.077	0
41	30	M1	1	-3.37	-98.245	9.565	262.718	14.713	0
42			2	7.439	15.089	-8.987	-75.621	-4.235	0
43	31	M1	1	-3.309	-82.784	11.548	238.83	13.375	0
44			2	6.624	15.037	-10.85	-81.609	-4.57	0
45	32	M1	1	-3.371	-90.64	13.472	251.776	14.1	0
46			2	7.069	15.066	-12.658	-87.422	-4.896	0
47	33	M1	1	-3.406	-97.515	9.332	262.007	14.673	0
48			2	7.439	15.089	-8.767	-74.917	-4.196	0
49	34	M1	1	-3.376	-98.126	10.206	259.508	14.533	0
50			2	7.439	15.089	-9.589	-77.559	-4.344	0
51	35	M1	1	-3.326	-87.001	11.14	238.992	13.384	0
52			2	6.847	15.051	-10.466	-80.376	-4.501	0
53	36	M1	1	-3.287	-84.75	11.781	241.453	13.522	0
54			2	6.698	15.042	-11.069	-82.314	-4.61	0
55	37	M1	1	-3.299	-87.544	12.773	247.614	13.867	0
56			2	6.847	15.051	-12	-85.308	-4.778	0

Member Section Forces (By Item) (Continued)

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Moment[k-...]	z-z Moment[k-...
57	38	M1	1	-3.407	-89.893	13.531	257.169	14.402	0
58			2	7.069	15.066	-12.713	-87.598	-4.906	0
59	39	M1	1	-3.435	-99.97	11.256	261.834	14.664	0
60			2	7.587	15.099	-10.576	-80.729	-4.521	0
61	40	M1	1	-.393	-54.279	2.333	18.606	1.042	0
62			2	3.037	.195	-2.192	-7.046	-.395	0
63	41	M1	1	-.569	-79.544	3.908	15.032	.842	0
64			2	4.445	.285	-3.671	-11.801	-.661	0
65	42	M1	1	-.559	-81.262	3.908	21.645	1.212	0
66			2	4.519	.29	-3.671	-11.801	-.661	0
67	43	M1	1	-.754	-109.19	5.074	32.964	1.846	0
68			2	6.075	.39	-4.767	-15.324	-.858	0
69	44	M1	1	-.925	-137.606	6.59	22.207	1.244	0
70			2	7.63	.49	-6.192	-19.903	-1.115	0
71	45	M1	1	-1.065	-156.034	7.757	29.192	1.635	0
72			2	8.667	.556	-7.288	-23.426	-1.312	0
73	46	M1	1	-1.08	-154.193	10.09	70.297	3.937	0
74			2	8.593	.551	-9.48	-30.472	-1.707	0
75	47	M1	1	-1.08	-158.756	12.423	76.012	4.257	0
76			2	8.816	.566	-11.672	-37.518	-2.101	0
77	48	M1	1	-1.001	-151.261	7.407	29.628	1.659	0
78			2	8.371	.537	-6.959	-22.369	-1.253	0
79	49	M1	1	-1.11	-164.222	8.457	36.7	2.055	0
80			2	9.112	.585	-7.945	-25.54	-1.43	0
81	50	M1	1	-1.178	-168.914	9.623	32.275	1.808	0
82			2	9.408	.604	-9.041	-29.062	-1.628	0
83	51	M1	1	-1.163	-172.269	10.381	42.632	2.388	0
84			2	9.556	.613	-9.754	-31.352	-1.756	0
85	52	M1	1	-1.091	-163.095	11.548	68.563	3.84	0
86			2	9.038	.58	-10.85	-34.876	-1.953	0
87	53	M1	1	-1.058	-157.691	12.423	89.477	5.011	0
88			2	8.741	.561	-11.672	-37.518	-2.101	0
89	54	M1	1	-1.22	-180.213	9.74	51.294	2.873	0
90			2	10.001	.642	-9.151	-29.415	-1.647	0
91	55	M1	1	-.254	-41.908	2.333	128.013	7.169	0
92			2	2.296	.147	-2.192	-7.049	-.395	0
93	56	M1	1	-.373	-57.715	3.908	158.714	8.889	0
94			2	3.185	.204	-3.671	-11.806	-.661	0
95	57	M1	1	-.402	-60.173	3.908	168.912	9.46	0
96			2	3.334	.214	-3.671	-11.806	-.661	0
97	58	M1	1	-.584	-82.288	5.074	236.432	13.241	0
98			2	4.593	.295	-4.767	-15.331	-.859	0
99	59	M1	1	-.714	-100.899	6.59	282.147	15.801	0
100			2	5.63	.361	-6.192	-19.912	-1.115	0
101	60	M1	1	-.76	-110.602	7.757	303.297	16.986	0
102			2	6.149	.395	-7.288	-23.435	-1.312	0
103	61	M1	1	-.632	-91.929	10.09	274.482	15.372	0
104			2	5.112	.328	-9.48	-30.479	-1.707	0
105	62	M1	1	-.693	-101.327	12.423	290.093	16.246	0
106			2	5.63	.361	-11.672	-37.525	-2.102	0
107	63	M1	1	-.735	-109.577	7.407	302.22	16.925	0
108			2	6.075	.39	-6.959	-22.378	-1.253	0
109	64	M1	1	-.767	-110.459	8.457	299.221	16.758	0
110			2	6.149	.395	-7.945	-25.548	-1.431	0
111	65	M1	1	-.679	-97.049	9.623	274.751	15.387	0
112			2	5.408	.347	-9.041	-29.07	-1.628	0
113	66	M1	1	-.66	-94.408	10.381	277.666	15.55	0

0-31

Company : LHB
Designer : jdf
Job Number : 090147

Bridge 69801 3A Pier 4

Apr 26, 2010
11:18 AM
Checked By: _____

Member Section Forces (By Item) (Continued)

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Moment[k-...	z-z Moment[k-...
114			2	5.26	.337	-9.754	-31.36	-1.756	0
115	67	M1	1	-647	-97.701	11.548	284.986	15.96	0
116			2	5.408	.347	-10.85	-34.883	-1.954	0
117	68	M1	1	-737	-100.43	12.423	296.339	16.596	0
118			2	5.63	.361	-11.672	-37.525	-2.102	0
119	69	M1	1	-743	-112.463	9.74	302.087	16.918	0
120			2	6.223	.399	-9.151	-29.423	-1.648	0

0-32

Jennifer French

From: Gao, Yihong (DOT) [Yihong.Gao@state.mn.us]
Sent: Thursday, March 18, 2010 4:30 PM
To: Jon Siiter
Cc: Jennifer French; Johnson, Lowell (DOT); Dimaculangan, Moises (DOT)
Subject: RE: MnDOT SS - Bridge 69801 Design, Legal, and Permit Live Load Factors

Jon,

Yes, I think these live load factors are consistent with what we use for superstructures. As for next lane loading, I think we will still use full legal loads not taking 75% of the weight considering the truck weight could have up to 5% tolerance.

Thanks,

Yihong



Yihong Gao, PE
Bridge Rating Engineer
MnDOT Bridge Office
3485 Hadley Avenue N.
Oakdale, MN 55128-3307
TEL: 651-366-4492
EMAIL: yihong.gao@state.mn.us

From: Jon Siiter [mailto:Jon.Siiter@lhbcorp.com]
Sent: Wednesday, March 17, 2010 4:15 PM
To: Gao, Yihong (DOT)
Cc: Jennifer French
Subject: FW: MnDOT SS - Bridge 69801 Design, Legal, and Permit Live Load Factors

Yihong, please see attached e-mail for input we received from the author of the Manual for Bridge Evaluation. You will see that there are not explicit rules for load factors when rating piers. We believe the summary Jen gives below is appropriate, except that we would not be using 1.15 for any of the standard permit trucks since they are not single trip vehicles. Any input you may have or concurrence would be appreciated. Thanks.

From: Jennifer French
Sent: Wednesday, March 17, 2010 3:36 PM
To: Jon Siiter
Cc: Jennifer French
Subject: MnDOT SS - Bridge 69801 Design, Legal, and Permit Live Load Factors

Jon, I've contacted Bala Sivakumar who wrote the Manual for Bridge Evaluation. With his input (see the email string below), I propose the following Live Load Factors. Bala's credentials are located in the attached PDF.

- Design: Inventory of 1.75 and Operating of 1.35
- Legal/Posting: 1.35
- Permit for routine and multiple trips: 1.35
- Permit for single trips: 1.15 (using permit and legal trucks when not escorted, using only permit truck when escorted).

What are your thoughts?

Jen

From: Bala Sivakumar [mailto:bsivakumar@HNTB.com]
Sent: Wednesday, March 17, 2010 3:14 PM
To: Jennifer French
Subject: RE: MnDOT SS - Bridge 69801 Permit Load Factors

My comments below. Good luck

Bala Sivakumar, P.E.
Vice President
Director-Special Bridge Projects

HNTB Corporation
5 Penn Plaza
6th Floor
New York, NY 10001-1810

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Mobile (201) 306-7852
www.hntb.com

From: Jennifer French [mailto:Jennifer.French@lhbcorp.com]
Sent: Wednesday, March 17, 2010 2:06 PM
To: Bala Sivakumar
Cc: Jennifer French
Subject: RE: MnDOT SS - Bridge 69801 Permit Load Factors

Bala, thank you for talking with me on the phone. As I mentioned, I will try to summarize our conversation here to verify that I have collected your thoughts correctly. A reply with any revisions would be appreciated.

Background:

- There have not been calibration studies for Substructure elements.
- Load Factors in the MBE pertain to longitudinal superstructure elements using LRFD distribution factors not lever rule.
- The MBE live load factors are calibrated based on the likelihood of side by side trucks, while a transverse substructure member would be affected more by direct loading and therefore is different.
- There is no guidance in the MBE for substructure review with legal or permit loads at this time. Planned for the future.
- Routine permits are not much different than heavy posting trucks in most states as they operate with no restrictions just like legal loads. For load rating purposes they may be considered the same – conservative assumption.
- Routine permits should be considered differently than special permits that operate in a more controlled fashion in terms of weight and number of trips.
- You (Bala) have been awarded a contract to review some of the issues I brought up below under an NCHRP 20-07 contract that will recalibrate LRFD load factors for permits for use with non LRFD distribution factor methods such as refined analysis .

Design Loading Recommendations:

- Use two lanes loaded with HL-93 loading.
- Use HL-93 loading with the 1.35 and 1.75 factors for operating and inventory, respectively.

Posting/Legal Truck Recommendations:

- Use one posting vehicle in one lane with one legal vehicle in the other.
- As the probability of loading is similar to HL-93 STRENGTH II case, use the comparable load factor of 1.35.

Routine Permit Truck Recommendations (and multiple trips):

- Use one permit truck in one lane with one legal vehicle in the other.
- Use the same load factor as for Posting trucks. Use load factor of 1.35.

Special Permit Truck Recommendations (single trips):

- Use one permit vehicle only or one permit vehicle in one lane with one legal vehicle in the other. A definite choice is not clear. Thoughts include:
 - Heavy permit truck in one lane with no truck in the second. This is most likely as the chance of a truck in the other lane is small. However this could be unconservative as a second truck could be occupying the second lane.
 - Heavy permit truck in one lane with legal truck in the second. Not likely, but possible.
 - Heavy permit truck in one lane with a 65 kip truck (approximately 80% of legal truck) in the second. More likely.
- Use a live load factor of 1.15 for these conditions. LRFR load factor for single trip special permits
- I (Jen) suggested using the 1.15 factor with a permit truck in one lane and legal truck in the other, and you (Bala) said that would be conservative and then suggested using the permit truck plus 80% of the legal truck loading.

I will be happy to send you a copy of this rating once it is completed as I understand you would like to use real-world design data for a project you have coming up. As mentioned in our conversation, I will have to ask MnDOT permission to send you this information.

Again, thank you for your time in reviewing my questions.

Jen

From: Jennifer French
Sent: Wednesday, March 17, 2010 11:20 AM
To: bsivakumar@hntb.com
Cc: Jennifer French
Subject: FW: MnDOT SS - Bridge 69801 Permit Load Factors

Bala, thank you for taking the time to consider this email. I called and left a message that I would be sending you this question.

I am rating a fracture critical integral steel box-beam pier cap at a highway interchange here in Duluth. I have been following the Manual for Bridge Evaluation F (First Edition/2008) as well as the AASHTO LRFD Bridge Design Specification (With revisions through 2009).

I am looking for some input/advice on what live load factors should be used for the permit and posting trucks when using LRFR for fracture critical piers (Substructure).

In section 6A.1.8.2 Substructures: It states "load rating of substructure elements should be done using the Strength I load combination and load factors of LRFD Design Article 3.4.1, including all...." To me this means that the live load factor would be 1.75 for design, legal, and permit ratings. Is this correct? If not, should we use the Tables in 6A.4.2.3 through 6A.4.2.5? I am concerned about using the values from these tables due to their values being based on the Lane Distribution Factors as all of my load distribution has been done using simple statics like the lever rule.

Some background on the pier cap:

- It was designed in 1966 using ASD.
- We have been requested to use LRFR for rating.

- It supports 2 lanes.
- Under design loads, the rating factor is below 1.0. (Using live load factors of 1.35 and 1.75)
- We will be designing a reinforcement scheme.
- The ADTT is 1050.
- When running the permit trucks, I have been instructed to run one permit truck with one legal truck in the other lane.
- When running the posting trucks, I have been instructed to run one posting truck with the worst legal truck in the other lane.

I appreciate your help. Please feel free to call me at the number below if you have questions.

Thanks,

Jen French

Jennifer French, PE (MN, MI)
Senior Structural Engineer
LHB
21 West Superior Street, Suite 500
Duluth, MN 55802
Direct Dial: 218-279-2461

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MnDOT Special Structures, 69801J
Pier Cap P4-3A Reactions under posting and permit loads
11-Jun-10
By: JDF

✓com
6/25/10

Risa						Girder A		Girder F		Risa				Braking Force		Proportion		Risa					
Girder		Total Truck		Reaction at		Torsion at		Wheel Load		Torsion (kip-		Torsion (kip		Combined LL		of HL-93 CF		Pier		Torque LL			
LC	Truck:	Weight (kip)	P4-3A (kip)	P4-3A (k-ft)	(kip)	ft) Pos 1	ft) Pos 2	BLC	Truck Combination	Reaction (kip)	to use	Weight (kip)	(kip) = 0.25*Truck	to use	LC	Vx LL (kip)	(kip)	RF:		RF:			
Two Lanes of Traffic	34	POST-TYPE3UNIT R	48	47.27	-10.91	23.64	6.97	2.07	20	Type 3 + SU7 R	122.42	0.88	125.5	31.375	0.87	10	-76.901	23.855	2.06		2.42		
	35	POST-TYPE3S2-40UNIT R	80	69.30	2.43	34.65	1.55	0.46	21	Type 3S2-40 + SU7 R	144.44	1.03	157.5	39.375	1.09	11	-79.134	27.979	1.97		2.31		
	36	POST-TYPE3S3UNIT R	80	70.83	-8.93	35.42	5.70	1.70	22	Type 3S3 + SU7 R	145.98	1.05	157.5	39.375	1.09	12	-79.431	27.98	1.96		2.31		
	37	POST-SU4-TRUCK R	54	0.00	0.00	0.00	0.00	0.00															
	38	POST-SU5-TRUCK R	62	0.00	0.00	0.00	0.00	0.00															
	39	POST-SU6-TRUCK R	69.5	0.00	0.00	0.00	0.00	0.00															
	40	POST-SU7-TRUCK R	77.5	75.15	-8.89	37.57	5.68	1.69															
	41	PERMIT-STD-A-TRUCK R	104	95.18	-16.36	47.59	10.45	3.11	23	Std A + SU7 R	170.33	1.22	181.5	45.375	1.26	13	-98.978	37.501	1.56		1.83		
	42	PERMIT-STD-B-TRUCK R	136	120.01	1.00	60.00	0.64	0.19	24	Std B + SU7 R	195.15	1.40	213.5	53.375	1.48	14	-122.733	28.599	1.32		1.55		
	43	PERMIT-STD-C-TRUCK R	159	136.05	-4.18	68.02	2.67	0.79	25	Std C +SU7 R	211.19	1.51	236.5	59.125	1.64	15	-137.99	34.295	1.17		1.38		
	44	PERMIT-P411-TRUCK R	207	134.38	37.18	67.19	23.76	7.06	26	P411 + SU7 R	209.52	1.50	284.5	71.125	1.98	16	-136.432	68.675	1.09		1.28		
	45	PERMIT-P413-TRUCK R	255	138.42	35.42	69.21	22.64	6.73	27	P413 + SU7 R	213.57	1.53	332.5	83.125	2.31	17	-140.309	73.375	1.05		1.23		
	46	PERMIT-STD-C152B R	152.2	131.94	-5.72	65.97	3.65	1.09	28	Std C152b + SU7 R	207.09	1.48	229.7	57.425	1.60	18	-134.062	34.846	1.20		1.41		
	47	PERMIT-STD-C174B R	174	143.20	-9.34	71.60	5.97	1.78	29	Std C174b + SU7 R	218.34	1.56	251.5	62.875	1.75	19	-144.814	40.739	1.10		1.30		
	48	PERMIT-STD-C198_23 R	198	147.22	1.32	73.61	0.84	0.25	30	Std C198_23 + SU7 R	222.37	1.59	275.5	68.875	1.91	20	-148.674	36.927	1.09		1.28		
	49	PERMIT-STD-C214B R	214	150.22	9.09	75.11	5.81	1.73	31	Std 214b + SU7 R	225.37	1.61	291.5	72.875	2.02	21	-151.519	45.589	1.05		1.23		
	50	PERMIT-STD-C237B R	237.4	142.25	30.88	71.12	19.73	5.87	32	Std C237b + SU7 R	217.39	1.56	314.9	78.725	2.19	22	-143.999	67.261	1.04		1.22		
	51	PERMIT-STD-C256B R	256	137.53	48.66	68.76	31.09	9.24	33	Std C256b + SU7 R	212.67	1.52	333.5	83.375	2.32	23	-139.396	84.783	1.03		1.21		
	52	PERMIT-STD-C200J R	200	157.15	-19.63	78.57	12.54	3.73	34	Std C200j + SU7 R	232.29	1.66	277.5	69.375	1.93	24	-158.14	52.838	0.99		1.17		
	53	POST-TYPE3UNIT T	48	36.60	-118.36	18.30	75.63	22.49	35	Type 3 + SU7 T	94.27	0.68	125.5	31.375	0.87	25	-59.099	173.454	1.41		1.65		
	54	POST-TYPE3S2-40UNIT T	80	50.36	-143.54	25.18	91.72	27.27	36	Type 3S2-40 + SU7 T	108.03	0.77	157.5	39.375	1.09	26	-60.438	177.579	1.38		1.62		
	55	POST-TYPE3S3UNIT T	80	52.49	-153.55	26.24	98.12	29.17	37	Type 3S3 + SU7 T	110.16	0.79	157.5	39.375	1.09	27	-60.736	177.579	1.37		1.61		
	56	POST-SU4-TRUCK T	54	0.00	0.00	0.00	0.00	0.00															
	57	POST-SU5-TRUCK T	62	0.00	0.00	0.00	0.00	0.00															
	58	POST-SU6-TRUCK T	69.5	0.00	0.00	0.00	0.00	0.00															
	59	POST-SU7-TRUCK T	77.5	57.67	-185.19	28.84	118.34	35.19															
	60	PERMIT-STD-A-TRUCK T	104	71.69	-216.17	35.85	138.14	41.07	38	Std A + SU7 T	129.36	0.93	181.5	45.375	1.26	28	-74.724	207.059	1.15		1.35		
	61	PERMIT-STD-B-TRUCK T	136	87.93	-256.29	43.96	163.77	48.70	39	Std B + SU7 T	145.60	1.04	213.5	53.375	1.48	29	-90.135	245.217	0.96		1.13		
	62	PERMIT-STD-C-TRUCK T	159	96.42	-273.39	48.21	174.69	51.94	40	Std C +SU7 T	154.09	1.10	236.5	59.125	1.64	30	-98.245	262.718	0.89		1.04		
	63	PERMIT-P411-TRUCK T	207	80.13	-237.72	40.07	151.90	45.17	41	P411 + SU7 T	137.80	0.99	284.5	71.125	1.98	31	-82.784	238.83	1.01		1.19		
	64	PERMIT-P413-TRUCK T	255	88.35	-245.69	44.17	156.99	46.68	42	P413 + SU7 T	146.02	1.05	332.5	83.125	2.31	32	-90.64	251.776	0.95		1.11		
	65	PERMIT-STD-C152B T	152.2	95.56	-273.42	47.78	174.72	51.95	43	Std C152b + SU7 T	153.23	1.10	229.7	57.425	1.60	33	-97.515	262.007	0.89		1.05		
	66	PERMIT-STD-C174B T	174	96.28	-267.17	48.14	170.72	50.76	44	Std C174b + SU7 T	153.95	1.10	251.5	62.875	1.75	34	-98.126	259.508	0.90		1.05		
	67	PERMIT-STD-C198_23 T	198	84.59	-239.45	42.29	153.01	45.49	45	Std C198_23 + SU7 T	142.26	1.02	275.5	68.875	1.91	35	-87.001	238.992	0.99		1.16		
	68	PERMIT-STD-C214B T	214	82.29	-239.92	41.14	153.31	45.58	46	Std 214b + SU7 T	139.96	1.00	291.5	72.875	2.02	36	-84.75	241.453	1.00		1.17		
	69	PERMIT-STD-C237B T	237.4	85.22	-243.43	42.61	155.55	46.25	47	Std C237b + SU7 T	142.89	1.02	314.9	78.725	2.19	37	-87.544	247.614	0.97		1.14		
	70	PERMIT-STD-C256B T	256	87.46	-251.82	43.73	160.91	47.85	48	Std C256b + SU7 T	145.13	1.04	333.5	83.375	2.32	38	-89.893	257.169	0.94		1.10		
	71	PERMIT-STD-C200J T	200	98.11	-265.93	49.05	169.93	50.53	49	Std C200j + SU7 T	155.78	1.12	277.5	69.375	1.93	39	-99.97	261.834	0.88		1.04		

06 Apr-10

								HL-93 CF Pier Reaction (kip) 139.6				HL-93 Braking Force (Kip) 36				Gamma DL1.25 VDL (kip) 129.4 D (in) 26 Ao (in^2) 812.5 Gamma LL1.35 C (kip) 407.2 Gamma LL1.15 Single Trip				Multiple Trip		Single Trip	
Risa Girder								Risa Pier				Risa Pier				Risa Pier							
LC Truck:		Total Truck Weight (kip)	Reaction at P4-3A (kip)	Torsion at P4-3A (k-ft)	Wheel Load (kip)	Girder A Torsion (kip- ft) Pos 1	Girder F Torsion (kip ft) Pos 2	Combined LL Reaction (kip)		Proportion of HL-93 CF to use	Combined Truck Weight (kip)		Braking Force (kip) = 0.25*Truck	Proportion of HL-93 BF to use	Vx LL (kip) Torque LL (kip)		RF:	RF:					
Two Lanes of Traffic	34	POST-TYPE3UNIT R	48	47.27	-10.91	23.64	6.97	2.07	20	Type 3 + SU7 R	122.42	0.88	125.5	31.375	0.87	10	-76.901	23.855	2.12	2.48			
	35	POST-TYPE3S2-40UNIT R	80	69.30	2.43	34.65	1.55	0.46	21	Type 3S2-40 + SU7 R	144.44	1.03	157.5	39.375	1.09	11	-79.134	27.979	2.03	2.38			
	36	POST-TYPE3S3UNIT R	80	70.83	-8.93	35.42	5.70	1.70	22	Type 3S3 + SU7 R	145.98	1.05	157.5	39.375	1.09	12	-79.431	27.98	2.02	2.37			
	37	POST-SU4-TRUCK R	54	0.00	0.00	0.00	0.00	0.00															
	38	POST-SU5-TRUCK R	62	0.00	0.00	0.00	0.00	0.00															
	39	POST-SU6-TRUCK R	69.5	0.00	0.00	0.00	0.00	0.00															
	40	POST-SU7-TRUCK R	77.5	75.15	-8.89	37.57	5.68	1.69															
	41	PERMIT-STD-A-TRUCK R	104	95.18	-16.36	47.59	10.45	3.11	23	Std A + SU7 R	170.33	1.22	181.5	45.375	1.26	13	-98.978	37.501	1.61	1.89			
	42	PERMIT-STD-B-TRUCK R	136	120.01	1.00	60.00	0.64	0.19	24	Std B + SU7 R	195.15	1.40	213.5	53.375	1.48	14	-122.733	28.599	1.36	1.60			
	43	PERMIT-STD-C-TRUCK R	159	136.05	-4.18	68.02	2.67	0.79	25	Std C +SU7 R	211.19	1.51	236.5	59.125	1.64	15	-137.99	34.295	1.20	1.41			
	44	PERMIT-P411-TRUCK R	207	134.38	37.18	67.19	23.76	7.06	26	P411 + SU7 R	209.52	1.50	284.5	71.125	1.98	16	-136.432	68.675	1.12	1.31			
	45	PERMIT-P413-TRUCK R	255	138.42	35.42	69.21	22.64	6.73	27	P413 + SU7 R	213.57	1.53	332.5	83.125	2.31	17	-140.309	73.375	1.08	1.27			
	46	PERMIT-STD-C152B R	152.2	131.94	-5.72	65.97	3.65	1.09	28	Std C152b + SU7 R	207.09	1.48	229.7	57.425	1.60	18	-134.062	34.846	1.24	1.45			
	47	PERMIT-STD-C174B R	174	143.20	-9.34	71.60	5.97	1.78	29	Std C174b + SU7 R	218.34	1.56	251.5	62.875	1.75	19	-144.814	40.739	1.13	1.33			
	48	PERMIT-STD-C198_23 R	198	147.22	1.32	73.61	0.84	0.25	30	Std C198_23 + SU7 R	222.37	1.59	275.5	68.875	1.91	20	-148.674	36.927	1.12	1.31			
	49	PERMIT-STD-C214B R	214	150.22	9.09	75.11	5.81	1.73	31	Std 214b + SU7 R	225.37	1.61	291.5	72.875	2.02	21	-151.519	45.589	1.08	1.26			
	50	PERMIT-STD-C237B R	237.4	142.25	30.88	71.12	19.73	5.87	32	Std C237b + SU7 R	217.39	1.56	314.9	78.725	2.19	22	-143.999	67.261	1.07	1.26			
	51	PERMIT-STD-C256B R	256	137.53	48.66	68.76	31.09	9.24	33	Std C256b + SU7 R	212.67	1.52	333.5	83.375	2.32	23	-139.396	84.783	1.06	1.24			
	52	PERMIT-STD-C200J R	200	157.15	-19.63	78.57	12.54	3.73	34	Std C200j + SU7 R	232.29	1.66	277.5	69.375	1.93	24	-158.14	52.838	1.02	1.20			
	53	POST-TYPE3UNIT T	48	36.60	-118.36	18.30	75.63	22.49	35	Type 3 + SU7 T	94.27	0.68	125.5	31.375	0.87	25	-59.099	173.454	1.45	1.70			
	54	POST-TYPE3S2-40UNIT T	80	50.36	-143.54	25.18	91.72	27.27	36	Type 3S2-40 + SU7 T	108.03	0.77	157.5	39.375	1.09	26	-60.438	177.579	1.42	1.66			
	55	POST-TYPE3S3UNIT T	80	52.49	-153.55	26.24	98.12	29.17	37	Type 3S3 + SU7 T	110.16	0.79	157.5	39.375	1.09	27	-60.736	177.579	1.41	1.66			
	56	POST-SU4-TRUCK T	54	0.00	0.00	0.00	0.00	0.00															
	57	POST-SU5-TRUCK T	62	0.00	0.00	0.00	0.00	0.00															
	58	POST-SU6-TRUCK T	69.5	0.00	0.00	0.00	0.00	0.00															
	59	POST-SU7-TRUCK T	77.5	57.67	-185.19	28.84	118.34	35.19															
	60	PERMIT-STD-A-TRUCK T	104	71.69	-216.17	35.85	138.14	41.07	38	Std A + SU7 T	129.36	0.93	181.5	45.375	1.26	28	-74.724	207.059	1.18	1.39			
	61	PERMIT-STD-B-TRUCK T	136	87.93	-256.29	43.96	163.77	48.70	39	Std B + SU7 T	145.60	1.04	213.5	53.375	1.48	29	-90.135	245.217	0.99	1.16			
	62	PERMIT-STD-C-TRUCK T	159	96.42	-273.39	48.21	174.69	51.94	40	Std C +SU7 T	154.09	1.10	236.5	59.125	1.64	30	-98.245	262.718	0.91	1.07			
	63	PERMIT-P411-TRUCK T	207	80.13	-237.72	40.07	151.90	45.17	41	P411 + SU7 T	137.80	0.99	284.5	71.125	1.98	31	-82.784	238.83	1.04	1.23			
	64	PERMIT-P413-TRUCK T	255	88.35	-245.69	44.17	156.99	46.68	42	P413 + SU7 T	146.02	1.05	332.5	83.125	2.31	32	-90.64	251.776	0.97	1.14			
	65	PERMIT-STD-C152B T	152.2	95.56	-273.42	47.78	174.72	51.95	43	Std C152b + SU7 T	153.23	1.10	229.7	57.425	1.60	33	-97.515	262.007	0.92	1.08			
	66	PERMIT-STD-C174B T	174	96.28	-267.17	48.14	170.72	50.76	44	Std C174b + SU7 T	153.95	1.10	251.5	62.875	1.75	34	-98.126	259.508	0.92	1.08			
	67	PERMIT-STD-C198_23 T	198	84.59	-239.45	42.29	153.01	45.49	45	Std C198_23 + SU7 T	142.26	1.02	275.5	68.875	1.91	35	-87.001	238.992	1.02	1.20			
	68	PERMIT-STD-C214B T	214	82.29	-239.92	41.14	153.31	45.58	46	Std 214b + SU7 T	139.96	1.00	291.5	72.875	2.02	36	-84.75	241.453	1.03	1.20			
	69	PERMIT-STD-C237B T	237.4	85.22	-243.43	42.61	155.55	46.25	47	Std C237b + SU7 T	142.89	1.02	314.9	78.725	2.19	37	-87.544	247.614	1.00	1.17			
	70	PERMIT-STD-C256B T	256	87.46	-251.82	43.73	160.91	47.85	48	Std C256b + SU7 T	145.13	1.04	333.5	83.375	2.32	38	-89.893	257.169	0.97	1.13			
	71	PERMIT-STD-C200J T	200	98.11	-265.93	49.05	169.93	50.53	49	Std C200j + SU7 T	155.78	1.12	277.5	69.375	1.93	39	-99.97	261.834	0.91	1.07			

S 6/11/10

								Multiple Presence Factor 1.2						Gamma DL 1.25		Multiple Trip Gamma LL 1.35		Single Trip Escorted Gamma LL 1.15		
Risa Girder		Total Truck	Reaction at	Torsion at	Wheel Load	Girder A	Girder F	Risa Pier	Factored LL	Proportion	Factored Truck	Braking Force	Proportion	Risa Pier	Torque LL					
LC	Truck:	Weight (kip)	P4-3A (kip)	P4-3A (k-ft)	(kip)	Torsion (kip-ft) Pos 1	Torsion (kip-ft) Pos 2	BLC	Truck Combination	Reaction (kip)	of HL-93 CF to use	Weight (kip)	(kip) = 0.25*Truck	of HL-93 BF to use	LC	Vx LL (kip)	(kip)	RF:	RF:	
One Lane of Traffic	34	POST-TYPE3UNIT R	48	47.27	-10.91	23.64	6.97	N/A	50	Type 3 R	56.73	0.41	57.6	14.4	0.40	40	-54.279	18.606	2.96	3.48
	35	POST-TYPE3S2-40UNIT R	80	69.30	2.43	34.65	1.55	N/A	51	Type 3S2-40 R	83.16	0.60	96	24	0.67	41	-79.544	15.032	2.13	2.51
	36	POST-TYPE3S3UNIT R	80	70.83	-8.93	35.42	5.70	N/A	52	Type 3S3 R	85.00	0.61	96	24	0.67	42	-81.262	21.645	2.03	2.39
	41	PERMIT-STD-A-TRUCK R	104	95.181	-16.36	47.59	10.45	N/A	53	Std A R	114.22	0.82	124.8	31.2	0.87	43	-109.19	32.964	1.49	1.75
	42	PERMIT-STD-B-TRUCK R	136	120.006	1.00	60.00	0.64	N/A	54	Std B R	144.01	1.03	163.2	40.8	1.13	44	-137.606	22.207	1.25	1.46
	43	PERMIT-STD-C-TRUCK R	159	136.045	-4.18	68.02	2.67	N/A	55	Std C R	163.25	1.17	190.8	47.7	1.33	45	-156.034	29.192	1.09	1.28
	44	PERMIT-P411-TRUCK R	207	134.377	37.18	67.19	23.76	N/A	56	P411 R	161.25	1.16	248.4	62.1	1.73	46	-154.193	70.297	1.00	1.18
	45	PERMIT-P413-TRUCK R	255	138.424	35.42	69.21	22.64	N/A	57	P413 R	166.11	1.19	306	76.5	2.13	47	-158.756	76.012	0.97	1.14
	46	PERMIT-STD-C152B R	152.2	131.944	-5.72	65.97	3.65	N/A	58	Std C152b R	158.33	1.13	182.64	45.66	1.27	48	-151.261	29.628	1.12	1.31
	47	PERMIT-STD-C174B R	174	143.195	-9.34	71.60	5.97	N/A	59	Std C174b R	171.83	1.23	208.8	52.2	1.45	49	-164.222	36.7	1.02	1.20
	48	PERMIT-STD-C198_23 R	198	147.224	1.32	73.61	0.84	N/A	60	Std C198_23 R	176.67	1.27	237.6	59.4	1.65	50	-168.914	32.275	1.00	1.18
	49	PERMIT-STD-C214B R	214	150.223	9.09	75.11	5.81	N/A	61	Std C214b R	180.27	1.29	256.8	64.2	1.78	51	-172.269	42.632	0.97	1.13
	50	PERMIT-STD-C237B R	237.4	142.248	30.88	71.12	19.73	N/A	62	Std C237b R	170.70	1.22	284.88	71.22	1.98	52	-163.095	68.563	0.96	1.13
	51	PERMIT-STD-C256B R	256	137.528	48.66	68.76	31.09	N/A	63	Std C256b R	165.03	1.18	307.2	76.8	2.13	53	-157.691	89.477	0.95	1.11
	52	PERMIT-STD-C200J R	200	157.146	-19.63	78.57	12.54	N/A	64	Std C200j R	188.58	1.35	240	60	1.67	54	-180.213	51.294	0.91	1.07
	53	POST-TYPE3UNIT T	48	36.60	-118.36	18.30	75.63	N/A	65	Type 3 T	43.92	0.31	57.6	14.4	0.40	55	-41.908	128.013	2.00	2.35
	54	POST-TYPE3S2-40UNIT T	80	50.36	-143.54	25.18	91.72	N/A	66	Type 3S2-40 T	60.44	0.43	96	24	0.67	56	-57.715	158.714	1.53	1.80
	55	POST-TYPE3S3UNIT T	80	52.49	-153.55	26.24	98.12	N/A	67	Type 3S3 T	62.99	0.45	96	24	0.67	57	-60.173	168.912	1.46	1.71
	60	PERMIT-STD-A-TRUCK T	104	71.692	-216.17	35.85	138.14	N/A	68	Std A T	86.03	0.62	124.8	31.2	0.87	58	-82.288	236.432	1.05	1.24
	61	PERMIT-STD-B-TRUCK T	136	87.928	-256.29	43.96	163.77	N/A	69	Std B T	105.51	0.76	163.2	40.8	1.13	59	-100.899	282.147	0.87	1.02
	62	PERMIT-STD-C-TRUCK T	159	96.42	-273.39	48.21	174.69	N/A	70	Std C T	115.70	0.83	190.8	47.7	1.33	60	-110.602	303.297	0.80	0.94
	63	PERMIT-P411-TRUCK T	207	80.132	-237.72	40.07	151.90	N/A	71	P411 T	96.16	0.69	248.4	62.1	1.73	61	-91.929	274.482	0.92	1.08
	64	PERMIT-P413-TRUCK T	255	88.348	-245.69	44.17	156.99	N/A	72	P413 T	106.02	0.76	306	76.5	2.13	62	-101.327	290.093	0.86	1.00
	65	PERMIT-STD-C152B T	152.2	95.562	-273.42	47.78	174.72	N/A	73	Std C152b T	114.67	0.82	182.64	45.66	1.27	63	-109.577	302.22	0.81	0.95
	66	PERMIT-STD-C174B T	174	96.276	-267.17	48.14	170.72	N/A	74	Std C174b T	115.53	0.83	208.8	52.2	1.45	64	-110.459	299.221	0.81	0.95
	67	PERMIT-STD-C198_23 T	198	84.588	-239.45	42.29	153.01	N/A	75	Std C198_23 T	101.51	0.73	237.6	59.4	1.65	65	-97.049	274.751	0.90	1.06
	68	PERMIT-STD-C214B T	214	82.286	-239.92	41.14	153.31	N/A	76	Std C214b T	98.74	0.71	256.8	64.2	1.78	66	-94.408	277.666	0.91	1.06
	69	PERMIT-STD-C237B T	237.4	85.216	-243.43	42.61	155.55	N/A	77	Std C237b T	102.26	0.73	284.88	71.22	1.98	67	-97.701	284.986	0.88	1.03
	70	PERMIT-STD-C256B T	256	87.459	-251.82	43.73	160.91	N/A	78	Std C256b T	104.95	0.75	307.2	76.8	2.13	68	-100.43	296.339	0.85	1.00
	71	PERMIT-STD-C200J T	200	98.109	-265.93	49.05	169.93	N/A	79	Std C200j T	117.73	0.84	240	60	1.67	69	-112.463	302.087	0.80	0.94



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PROJECT MnDOT SS - 69801J - 3A.P4. Posting + Permit - Moment - 1

PROJECT # 090147 DATE 4/16/10 BY jdf ^{WCSM} _{6/25/10} SHEET NO. _____ OF _____

Evaluate the Pier cap for Flexure with
Std C 200j Loading w/ one lane loaded
only and a Multiple Presence Factor
of 1.2. See Enccalc L454

$$m_z = 2066.1 \checkmark \text{ kip}\cdot\text{ft}$$

$$m_y = 121.9 \checkmark \text{ kip}\cdot\text{ft}$$

Check Location that controlled for moment Before.
This is at section -i, located at the transition
of 3/8" to 1" web on the northern side
(@ 7.16', use 7.189')

$$R_n = M_{nc} = 36067 \checkmark \text{ kip}\cdot\text{in} \quad M_{nt} = 57018 \checkmark \text{ kip}\cdot\text{in}$$

$$M_{DL} = 791.3 \checkmark \text{ kip}\cdot\text{ft} = 9495.6 \checkmark \text{ kip}\cdot\text{in}$$

$$M_{LL+I}(x) = 1295.6 \checkmark \text{ kip}\cdot\text{ft}$$

$$M_{LL+I}(y) = 72.9 \checkmark \text{ kip}\cdot\text{ft}$$

$$S_x(\text{comp}) = S_x(\text{ten}) = 1458.0 \checkmark \text{ in}^3$$

$$S_y = 755.9 \checkmark \text{ in}^3$$

$$RF = \frac{C - \gamma_{DL} \times DL}{\gamma_{LL}(LL+IM)}$$

$$\gamma_{DL} = 1.25$$

$$\gamma_{LL \text{ permit}} = 1.35 \text{ (multiple trips)}$$

Compression Flange will control. $\checkmark$

$$C_{\phi_s=0.85} = \phi_s \phi_s \phi R_n = 1.0 \times .85 \times 1.0 \times 36067 = 30657 \checkmark \text{ kip}\cdot\text{in}$$

$$C_{\phi_s=0.95} = 1.0 \times .95 \times 1.0 \times 36067 = 34264 \checkmark \text{ kip}\cdot\text{in}$$

$$LL+IM = m_x + \frac{1}{3} \frac{m_y}{S_y} \times S_{xc} = \left(1295.6 + \frac{1}{3} \times \frac{72.9}{755.9} \times 1458.0 \right) \times 12 \text{ in} \\ = 16109.6 \checkmark \text{ kip}\cdot\text{in}$$

$$RF = \frac{30657 - 1.25 \times 9495.6}{1.35 \times 16109.6} = 0.86 \checkmark \text{ w/ } \phi_s = 0.85$$

$$\rightarrow 1.03 \checkmark \text{ w/ } \phi_s = 0.95 \quad 0-41$$



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PROJECT MnDOT SS-69801 J-3A.P4 - Posting & Permit - Moment - 2

PROJECT # 090147 DATE 4/16/10 BY jdf SHEET NO. _____ OF _____

6/25/10

The RF of 0.86 is greater than the shear/torsion
RF of 0.80⁷⁸. Therefore the shear/torsion
RF's still control. ✓

Beam: **M1**

Shape: **BR3A-4a-RevisedJ**

Material: **A36 Steel**

Length: **21.353 ft**

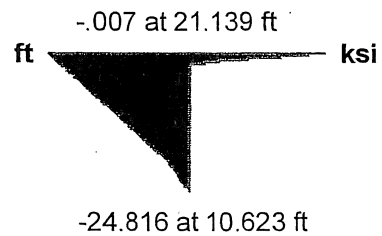
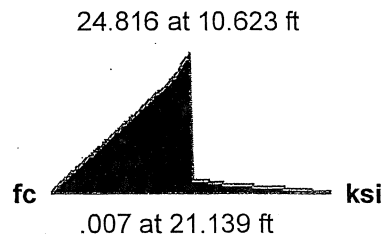
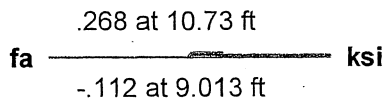
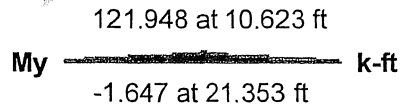
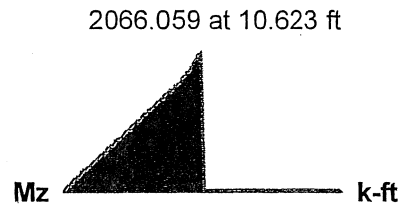
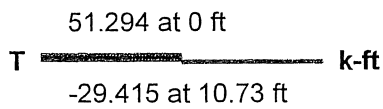
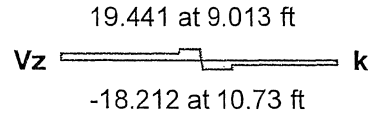
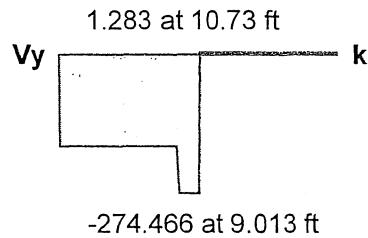
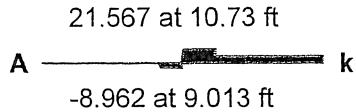
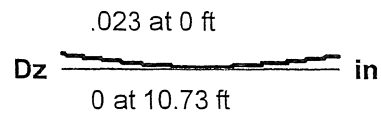
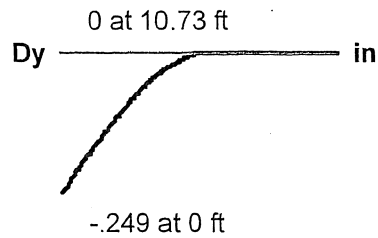
I Joint: **N2**

J Joint: **N6**

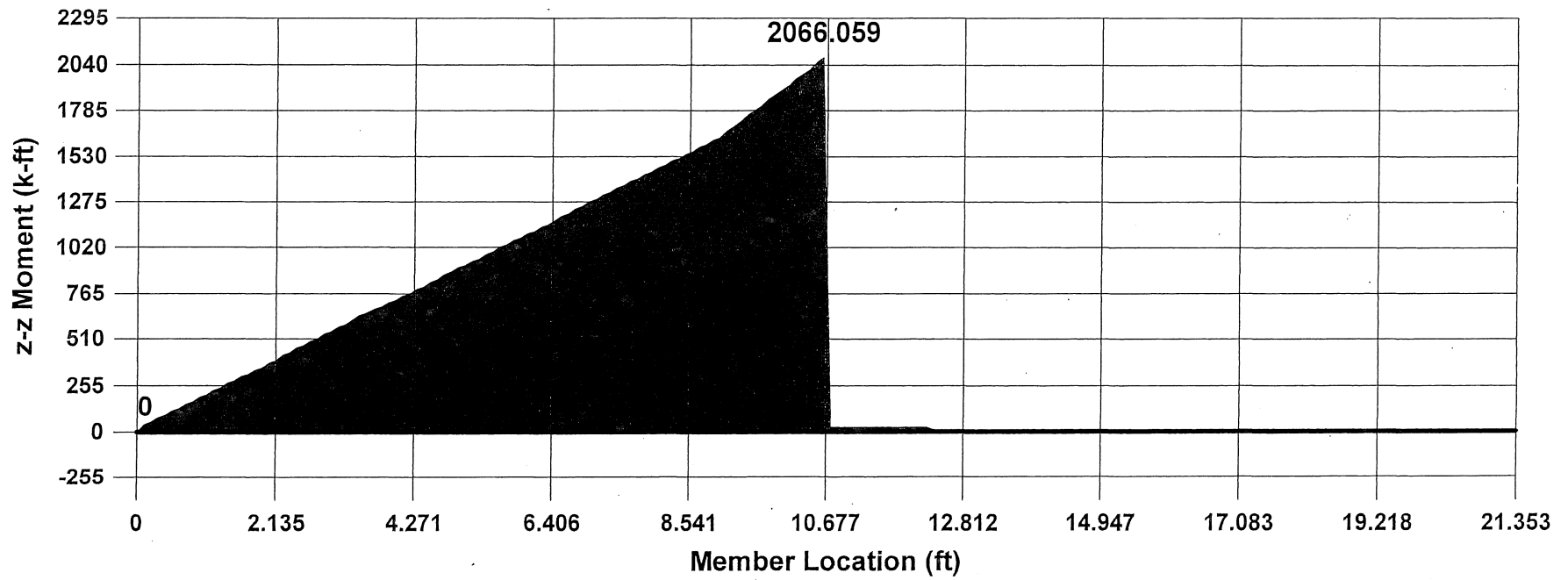
LC 54: Std C200j R

Code Check: **0.000 (bending)**

Report Based On 200 Sections



Member M1 , LC 54: Std C200j R

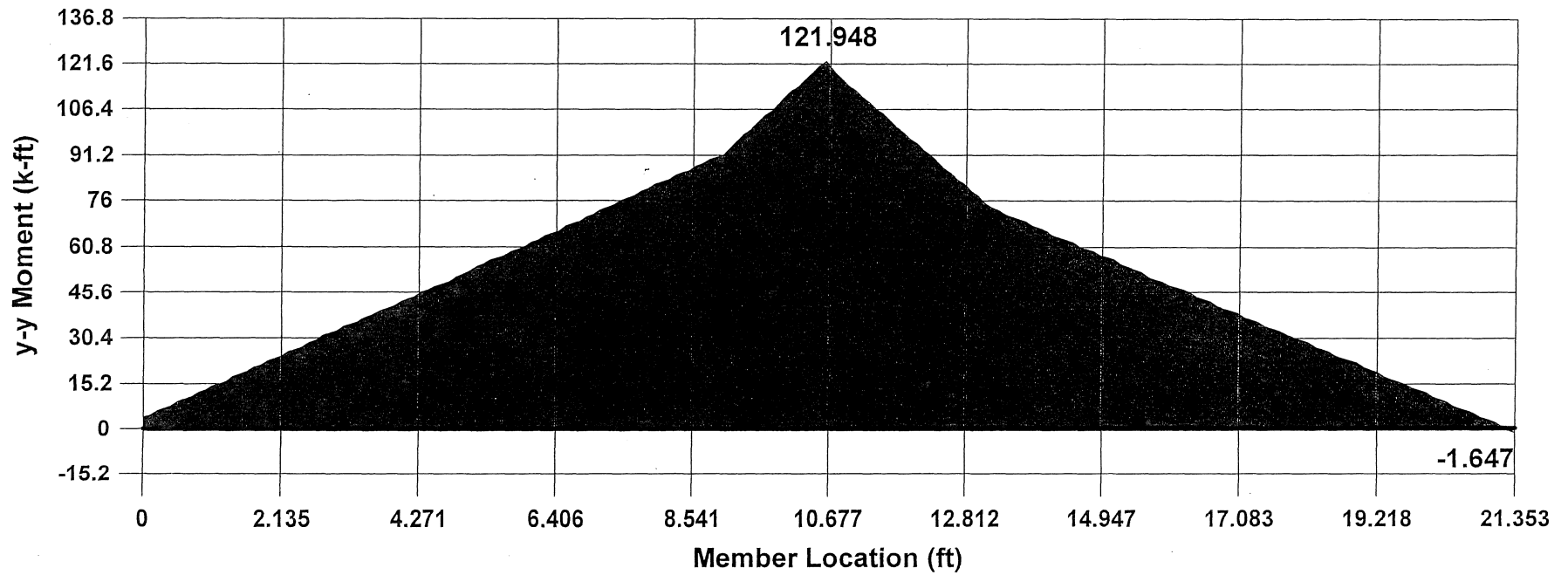


$$M_z @ 7.189' = 1295.611 \text{ kip}\cdot\text{ft}$$

✓
6/25/10
JCS

0-44

Member M1 , LC 54: Std C200j R



$$m_y @ 7.189' = 72.895 \text{ kip}\cdot\text{ft.}$$

VC SM
4/6/10

0-45



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PROJECT MnDOT SS-69801 J - PY.3A - Transverse Stiffeners - Posting Permit
PROJECT # 090147 DATE 4/19/10 BY jdf SHEET NO. 1 OF 1
VCsm
4/25/10

Check the Transverse Stiffeners now with the Permit and Posting Vehicle Loads.

Follow the previous calculations (pgs 1-8).

Use Single Traffic Lane w/ maximum Torque and accompanying Reaction for the Permit - Std - C200T Load Combination (Rise LC # 71).

Stiffener Type A @ 3/8" web:

$$V_u = 1.25 \times 129.1 + 1.75 \times 112.463 + \left(\frac{302.09 \times 12 \times 1 \times 26}{8 \times 25} \right)$$

$$= 161.4 + 399.8 = 561.2 \text{ kip.}$$

$$I_t \geq 4.44 + (4.44 - 3.89) \left(\frac{561.2 - 1.0 \times 310.1}{1.0 \times 650.7 - 1.0 \times 310.1} \right)$$

$$I_t \geq 4.85 \text{ in}^4, \quad I_t = 15.6 \text{ in}^4 \quad \underline{\text{OK}}$$

Stiffener Type A @ 1" web:

$$V_u = 561.2 \text{ kip.} \quad \checkmark \text{ (see above).}$$

$$V_u < \phi V_{cr} \quad \therefore \text{no change} \quad \underline{\text{OK}}$$

Stiffener Type B:

$$V_u = 275.2 + 1.75 \times \left[171.295 + 302.087 \times 12 \times 1 \times \frac{42}{1360.1} \right]$$

$$= 275.2 + 495.7 = 770.9 \text{ kip.}$$

$$V_u < \phi V_{cr} \quad \therefore \text{no change.} \quad \underline{\text{OK}}$$

Stiffener Type C: $\checkmark$ see above (conservative).

$$V_u = 276.4 + 495.7 = 772.1 \text{ kip.}$$

$$\uparrow \text{see pg 7}$$

$$V_u < \phi V_{cr} \quad \therefore \text{no change} \quad \underline{\text{OK}} \quad \checkmark$$

Stiffeners are OK for permit + posting loads.

0-46

69801J-3A-PA
Summary

FINAL RATING SUMMARY TABLE FOR PIER 69801J P4-3A

(LRFR method, System factor $\phi_s = 0.85$)

COMPLETED BY: JDF

CHECKED BY: CJM

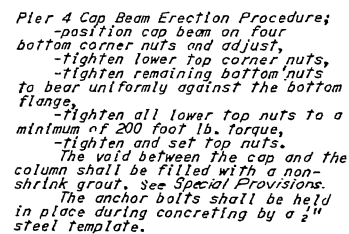
DATE: 6-11-10

DATE: 6/25/10

	TRUCK	MULTIPLE-TRIP		SINGLE-TRIP		COMMENTS
		RF	LOCATION	RF	LOCATION	
AASHTO	HL-93 INV	0.78	Girder A	N/A	N/A	Shear with Torsion controls in Maximum Torsion Load Case
	HL-93 OP	1.01	Girder A	N/A	N/A	Shear with Torsion controls in Maximum Torsion Load Case
Posting Vehicles	Type 3 +SU7	1.41	Girder A	N/A	N/A	Shear with Torsion controls in Maximum Torsion Load Case
	Type 3S2-40 + SU7	1.38	Girder A	N/A	N/A	Shear with Torsion controls in Maximum Torsion Load Case
	Type 3S3 + SU7	1.37	Girder A	N/A	N/A	Shear with Torsion controls in Maximum Torsion Load Case
Permit Vehicles * (Mix with traffic)	STD. A	1.02	Girder A	1.20	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	STD. B	0.85	Girder A	0.99	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	STD. C	0.78	Girder A	0.92	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	P411	0.90	Girder A	1.05	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	P413	0.83	Girder A	0.98	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	C152b	0.78	Girder A	0.92	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	C174b	0.79	Girder A	0.92	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	C198_23	0.87	Girder A	1.03	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	C214b	0.88	Girder A	1.03	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	C237b	0.85	Girder A	1.00	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	C256b	0.83	Girder A	0.97	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	C200j	0.78	Girder A	0.91	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
Permit Vehicles (Escorted with no other vehicles)	STD. A	N/A	N/A	1.20	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	STD. B	N/A	N/A	0.99	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	STD. C	N/A	N/A	0.92	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	P411	N/A	N/A	1.05	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	P413	N/A	N/A	0.98	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	C152b	N/A	N/A	0.92	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	C174b	N/A	N/A	0.92	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	C198_23	N/A	N/A	1.03	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	C214b	N/A	N/A	1.03	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	C237b	N/A	N/A	1.00	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	C256b	N/A	N/A	0.97	Girder A	Shear with Torsion controls in Maximum Torsion Load Case
	C200j	N/A	N/A	0.91	Girder A	Shear with Torsion controls in Maximum Torsion Load Case

* Single lane of traffic controls due to multiple presence factor of 1.2.

648010-3A-PA
GENERAL

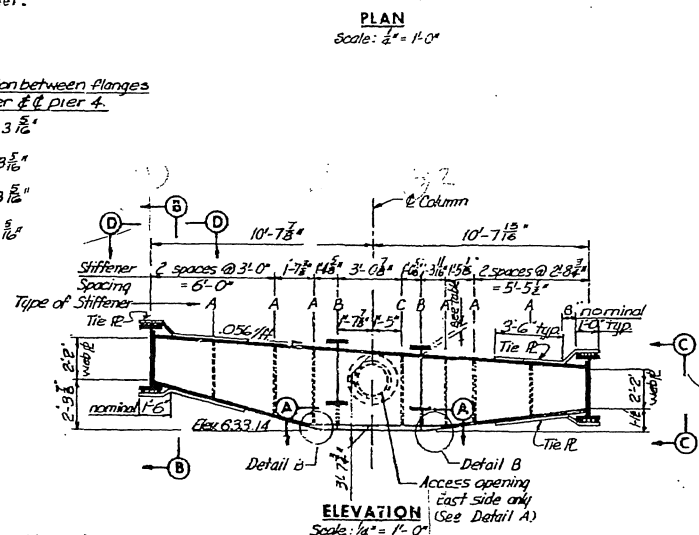


Note: Radii of Girders shall correspond to radii shown on Framing Plan Sheet.

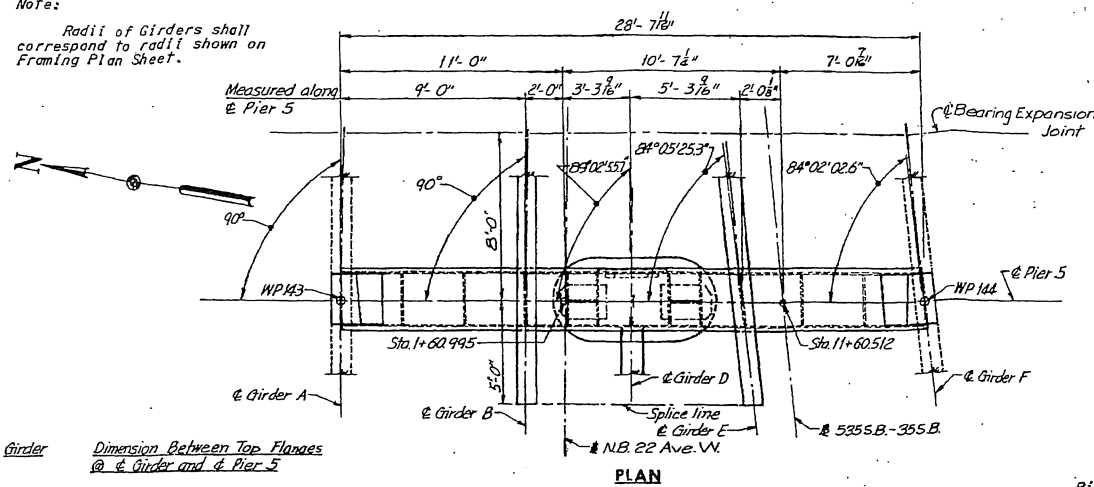
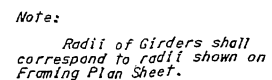
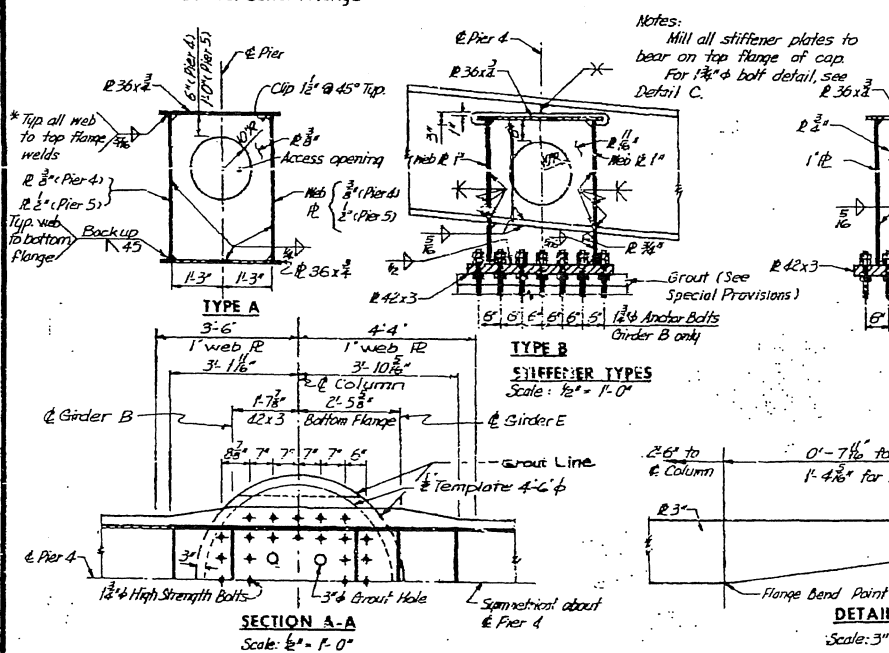
Girder Dimension between flanges
@ 4' girder & 4' pier 4.

A	$3\frac{5}{16}'$
B	$3\frac{5}{16}"$
E	$3\frac{5}{16}"$
F	$3\frac{5}{16}"$

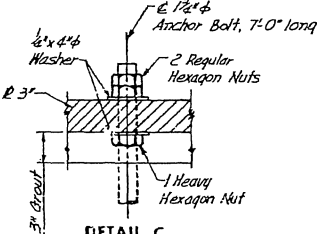
(D)



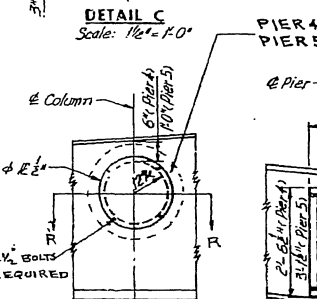
*Top flange to web weld may be groove welded as shown for bottom flange



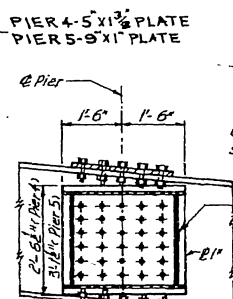
<u>Girder</u>	<u>Dimension Between Top Flanges @ 4' Girder and 4' Pier 5</u>
A	3"
B	3"
E	3"
F	3"



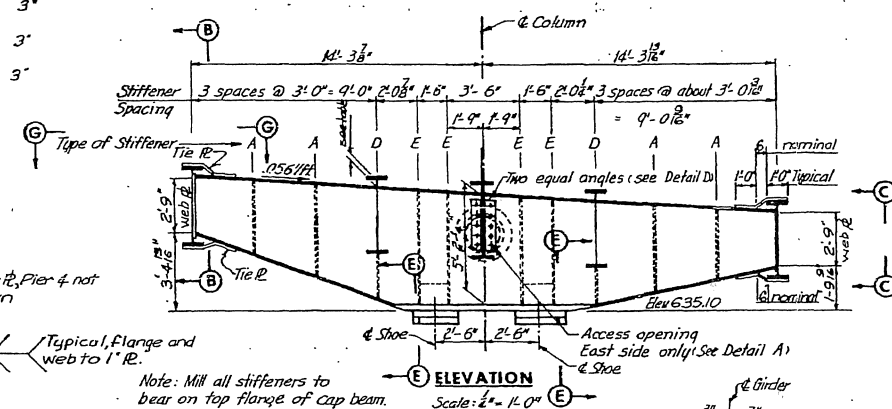
DETAIL C
Scale: $1\frac{1}{2}" = 1'-0"$



DETAIL A



SECTION B-B
Scale: 1/2" = 1'-0"



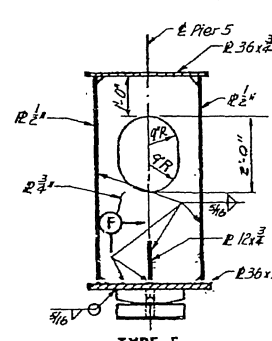
ELEVATION

Scale: $\frac{1}{2"} = 11'-0"$

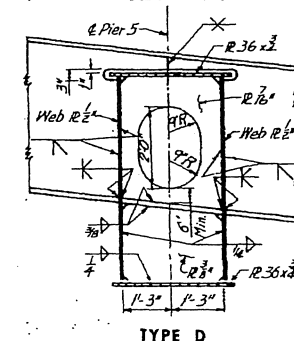
Shoe

Girder

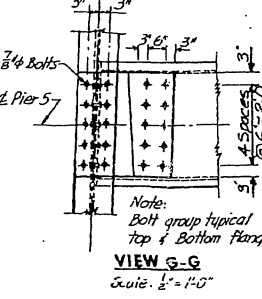
Note: Mill all stiffeners to bear on top flange of cap beam.



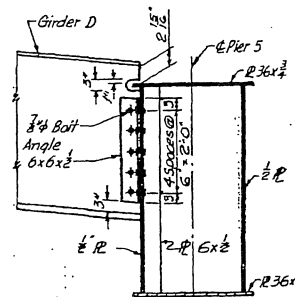
TYPE E



TYPE D



VIEW G-G
Scale: $\frac{1}{2}'' = 1'-0''$

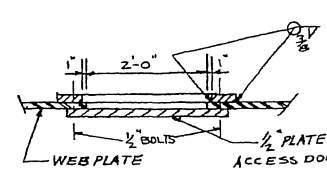


DETAIL D
Scale: $\frac{1}{2}" = 1'-0"$

- position cap beam on shoes,
- tighten tie down nuts,
- complete superstructure concrete on adjacent spans.
- release tie down nuts,
- over curved surfaces of tie down washers with heavy coating of grease.
- retighten tie down nuts to a minimum torque of 200 foot lb.

Anchor bolts shall be held in position during concreting by a 2" steel template.

Notes: For details of materials and finish not shown on shoes see Bearing Assembly Details.
For details of girder and beam sections not shown see Framing Plans.
Prior to placement of the deck concrete the entire area of the cap beam that will be in contact with the concrete shall be covered with a protective coating similar to that equal to Koppers Company Bitumastic 50.
The deck slab shall be haunched to the top of the cap beam.
No dead load camber is required



SECTION R-R

H.N.T.B. BR. NO. 2A, 2C-2K, 3A-3E
TRUNK HIGHWAY NO. 35
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS
INTERSTATE ROUTES IN DULUTH
BRIDGE NO. 69801

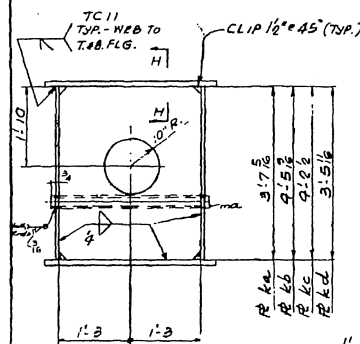
STEEL CAP BEAM DETAILS
PIER 4 AND PIER 5
BRIDGE 3A

APPROVED: 7-30-68

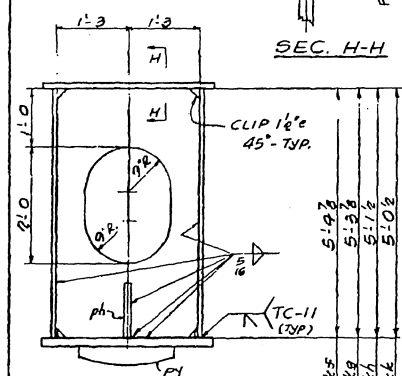
SHEET NO.86 OF 189 SHEETS 6980

DES.	TCY
DCH	REC
DR	TCY
CH.	BY

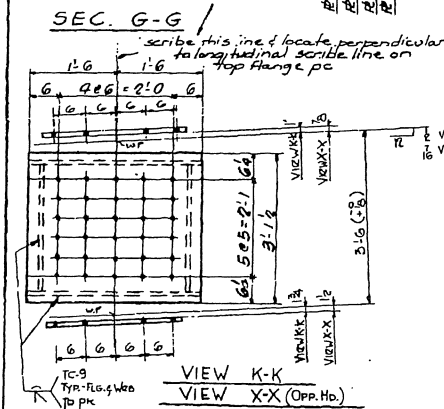




SEC. F-F

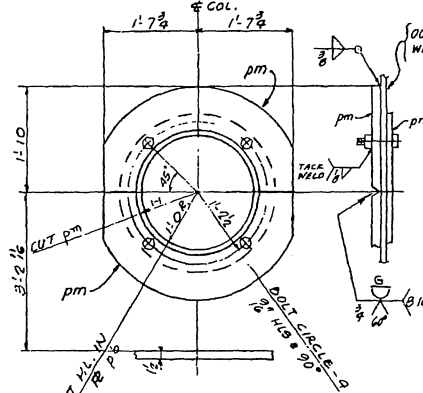


SEC. H-H

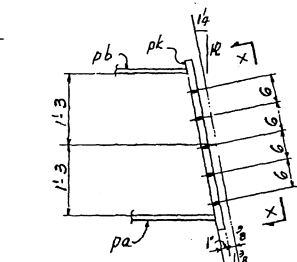


SEC. G-G

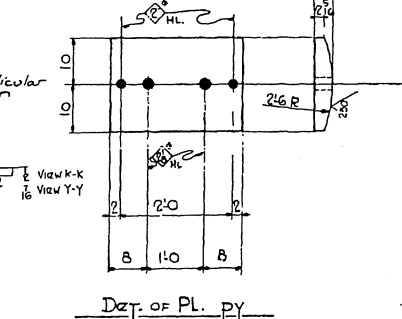
VIEW K-K
VIEW X-X (Opp. Ho.)



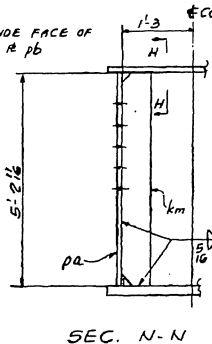
DET. 'M'



SEC. T-T



DET. OF PL. PY



SEC. N-N

GENERAL NOTES
 SPEC.: MINN. DEPT. OF HWY. SPEC. 1964 EDITION AND SUPPLEMENTARY SPEC. FEB. 1966 & SPECIAL PROVISIONS AND AASHTO 1965.
 MHD 330G (A3G MODIFIED)
 MATL.: MATL. MARKED "E" SHALL BE UM, FLAT, MACHINE FLAME CUT AND GROUND 1/2", OR EDGE PLANED. SEE MHD 2471.3C & AND D4.
 OPEN HOLES: 1/2" FOR HS BOLTS.
 REAMING: HOLES TO BE SUBPUNCHED OR SUBDRILLED 1/2" AND REAMED TO SIZE WHILE MATCHING MEMBERS ARE ASSEMBLED. SEE DWG. SAT-1 FOR MATCH MARKS & BLOCKING. SEE NOTE 'A'.
 SPlice REAMING AS PER MHD 2471.3E1b. OTHER REAMING AS PER MHD 2471.3E1c.

INSPECTION: SHOP INSPECTION BY M.M.D.
MAGNETIC PARTICLE INSP.: PER MHD 2471.3J4-d2 & SPECIAL PROVISIONS. (100% BBS STIFFS, 10% WEB & FLG. WELDS).
RADIOGRAPHIC INSP.: MHD 2471.3J4-d4 & SPECIAL PROVISIONS. (100% ALL BUTTWELDS - INDICATED "X-RAY" ON DWGS.).
WELDING: PER MHD 2471.3J, 3339 AND SPECIAL PROVISIONS. REMOVE ALL SHOP TACK WELDING ON SPlice PLATES.

PIPE NOTE: WELDING OF PIPE TO TOP FLG. MUST BE STRICTLY MAINTAINED. DO NOT DEVIATE FROM WELD SHOWN. DO NOT PAINT PIPE.

PAINT NOTE
 ONE COAT INORGANIC ZINC LEAD SILICATE COATING ON THE INSIDE PAR. SPACES - See page 195B of Special Provisions for sand blasting.
 ONE COAT RED LEAD (MHD 2506 SAND BLAST) ON THE OUTSIDE.
 TRUNK HIGHWAY NO. 35
 STATE OF MINNESOTA
 DEPARTMENT OF HIGHWAYS
 BRIDGE NO. 608
 TREXLE 22nd AVE. W. TO GARFIELD AVE.
 INTERCHANGE AT 22nd AVE. W. IN DULUTH
 S. P. NO. 580-18 (7/15/56-390)
 MINN. PROJ. NO. 1-587 (5) 251

NO.	DESCRIPTION	QTY.	UNIT	PRICE	TOTAL	REMARKS
1	CAP 2500	1	EA	713.00	713.00	
2	1 PL 30 x 1/2	10	LB	1.00	10.00	
3	1 PL 30 x 1/2	10	LB	1.00	10.00	
4	1 PL 30 x 1/2	10	LB	1.00	10.00	
5	1 PL 30 x 1/2	10	LB	1.00	10.00	
6	1 PL 30 x 1/2	10	LB	1.00	10.00	
7	1 PL 30 x 1/2	10	LB	1.00	10.00	
8	1 PL 30 x 1/2	10	LB	1.00	10.00	
9	1 PL 30 x 1/2	10	LB	1.00	10.00	
10	1 PL 30 x 1/2	10	LB	1.00	10.00	
11	1 PL 30 x 1/2	10	LB	1.00	10.00	
12	1 PL 30 x 1/2	10	LB	1.00	10.00	
13	1 PL 30 x 1/2	10	LB	1.00	10.00	
14	1 PL 30 x 1/2	10	LB	1.00	10.00	
15	1 PL 30 x 1/2	10	LB	1.00	10.00	
16	1 PL 30 x 1/2	10	LB	1.00	10.00	
17	1 PL 30 x 1/2	10	LB	1.00	10.00	
18	1 PL 30 x 1/2	10	LB	1.00	10.00	
19	1 PL 30 x 1/2	10	LB	1.00	10.00	
20	1 PL 30 x 1/2	10	LB	1.00	10.00	
21	1 PL 30 x 1/2	10	LB	1.00	10.00	
22	1 PL 30 x 1/2	10	LB	1.00	10.00	
23	1 PL 30 x 1/2	10	LB	1.00	10.00	
24	1 PL 30 x 1/2	10	LB	1.00	10.00	
25	1 PL 30 x 1/2	10	LB	1.00	10.00	
26	1 PL 30 x 1/2	10	LB	1.00	10.00	
27	1 PL 30 x 1/2	10	LB	1.00	10.00	
28	1 PL 30 x 1/2	10	LB	1.00	10.00	
29	1 PL 30 x 1/2	10	LB	1.00	10.00	
30	1 PL 30 x 1/2	10	LB	1.00	10.00	
31	1 PL 30 x 1/2	10	LB	1.00	10.00	
32	1 PL 30 x 1/2	10	LB	1.00	10.00	
33	1 PL 30 x 1/2	10	LB	1.00	10.00	
34	1 PL 30 x 1/2	10	LB	1.00	10.00	
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72	1 PL 30 x 1/2	10	LB	1.00	10.00	
73	1 PL 30 x 1/2	10	LB	1.00	10.00	
74	1 PL 30 x 1/2	10	LB	1.00	10.00	
75	1 PL 30 x 1/2	10	LB	1.00	10.00	
76	1 PL 30 x 1/2	10	LB	1.00	10.00	
77	1 PL 30 x 1/2	10	LB	1.00	10.00	
78	1 PL 30 x 1/2	10	LB	1.00	10.00	
79	1 PL 30 x 1/2	10	LB	1.00	10.00	
80	1 PL 30 x 1/2	10	LB	1.00	10.00	
81	1 PL 30 x 1/2	10	LB	1.00	10.00	
82	1 PL 30 x 1/2	10	LB	1.00	10.00	
83	1 PL 30 x 1/2	10	LB	1.00	10.00	
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96	1 PL 30 x 1/2	10	LB	1.00	10.00	
97	1 PL 30 x 1/2	10	LB	1.00	10.00	
98	1 PL 30 x 1/2	10	LB	1.00	10.00	
99	1 PL 30 x 1/2	10	LB	1.00	10.00	
100	1 PL 30 x 1/2	10	LB	1.00	10.00	

DN.1
 UNIT 3-3A
 CAP GIRDER-PIECE 5
 See PAINT NOTE.
 YES

AMERICAN BRIDGE DIVISION OF U.S. UNITED STATES STEEL
 GARY
 EXELROD
 KM
 BLAIR

ET01
 K2845
 713 C

(A) + (C) (5) - B



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Duluth, Minnesota 55802
218 727-8446
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250 3rd Avenue North, Suite 450
Minneapolis, Minnesota 55401
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Fax 612 338-2088

PROJECT MnDOT SS-69801J-P5-3A-Controlling Load Combination
PROJECT # 090147 DATE 1/19/10 BY jdf ^{✓ 5m} _{\$110/10} SHEET NO. _____ OF _____

Design Pier Cap Loading for

- ① 2 lanes of lane + truck loading
- ② 2 lanes of lane + tandem loading
- ③ 2 lanes of 0.9 lane + 0.9 (2 truck @ 50')

Reactions due to	Lane =	51.9 k ^{OK}
" " "	Truck =	71.3 k
" " "	Tandem =	54.1 k ^{OK}
" " "	2 trucks @ 50' =	81.6 k ^{OK}

changed minorly
due to Ixx revisions.
New loads not
incorporated.

What will control?

Impact factor is $1 + \frac{33}{100} = 1.33$ to ✓
truck or tandem loads only (not lane).

Reaction per lane.

- ① $51.9 + 1.33 \times 71.3 = 146.7 \text{ k}$ ✓ ← controls
- ② $51.9 + 1.33 \times 53.1 = 122.5 \text{ k}$ ^{OK}
- ③ $0.9 \times 51.3 + 0.9 \times 1.33 \times 81.6 = 143.8 \text{ k}$ ✓

1.0 Lane + 1.0 Truck Controls



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Duluth, Minnesota 55802
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250 3rd Avenue North, Suite 450
Minneapolis, Minnesota 55401
612 338-2029
Fax 612 338-2088

PROJECT MnDOT SS-69801 J - P5-3A - Risa model -1
PROJECT # 090147 DATE 12/16/09 BY jdf ^{✓CSM}
SHEET NO. _____ OF _____
5/11/10

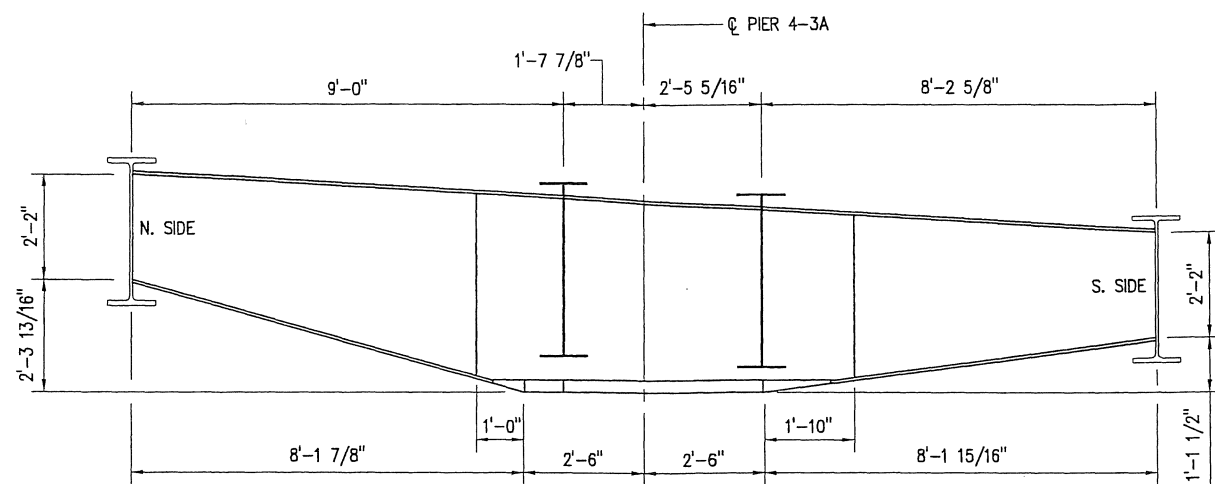
Risa model Use Section P5-1 for Pier Section.
Actual section used does not affect design as
only forces are used from the model, not
stresses and pier cap is a determinate
structure. ✓

MDX dead Load Reactions suggest that Girder
D does not carry much of the load. ✓

Also, Girder D is a pinned connection to the face
of Pier 5 Cap Beam which is more flexible
than the neighboring continuous spans w/ hinges. ✓

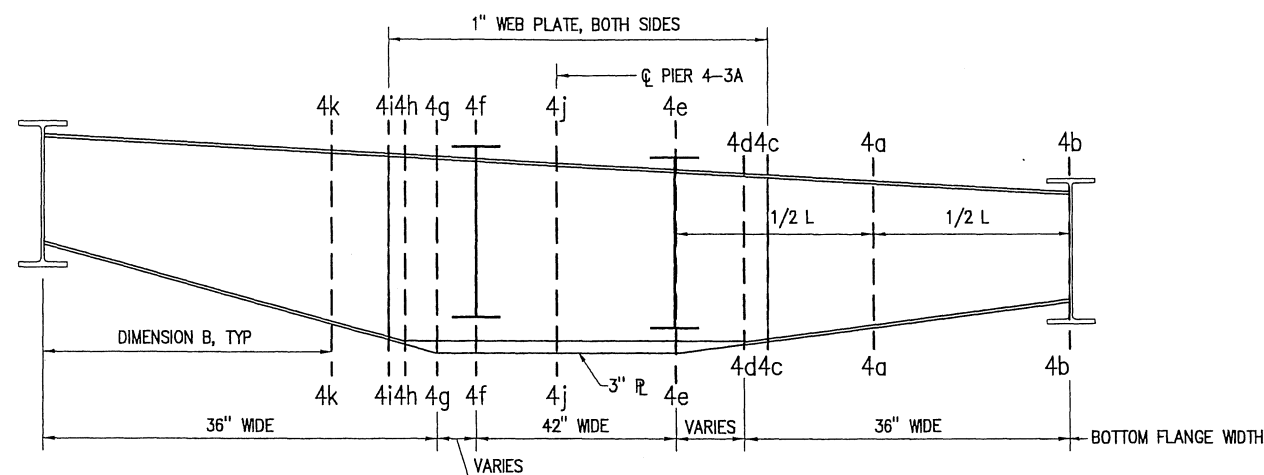
We will model Pier Cap P5-3A two ways:

- 1) With Girder D transferring slab loads to the
pier cap (causes the maximum shear).
- 2) Without Girder D transferring slab loads to
the pier cap (causes the maximum moment). ✓



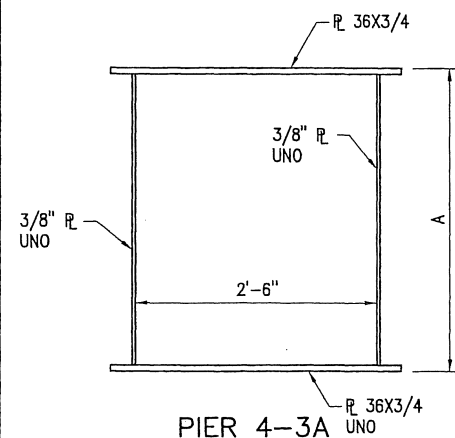
PIER 4-3A GEOMETRY

SCALE: 0 2'

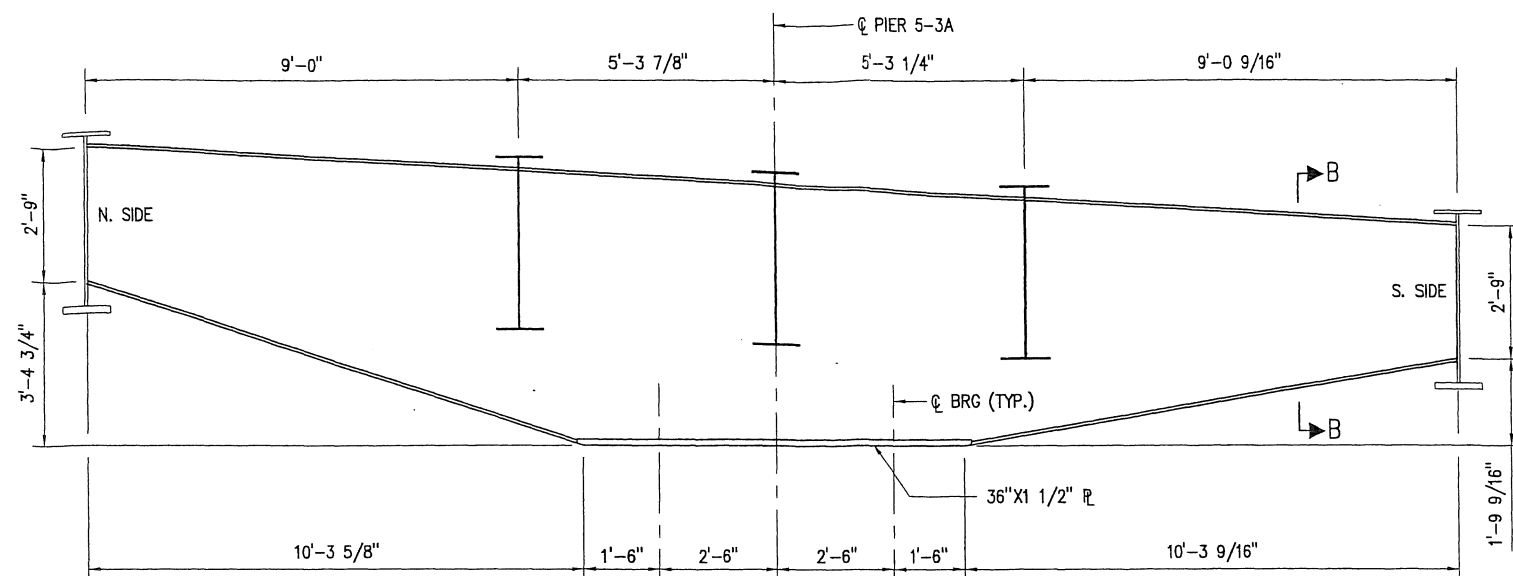


PIER 4-3A SECTION CUTS

SCALE: 0 2'

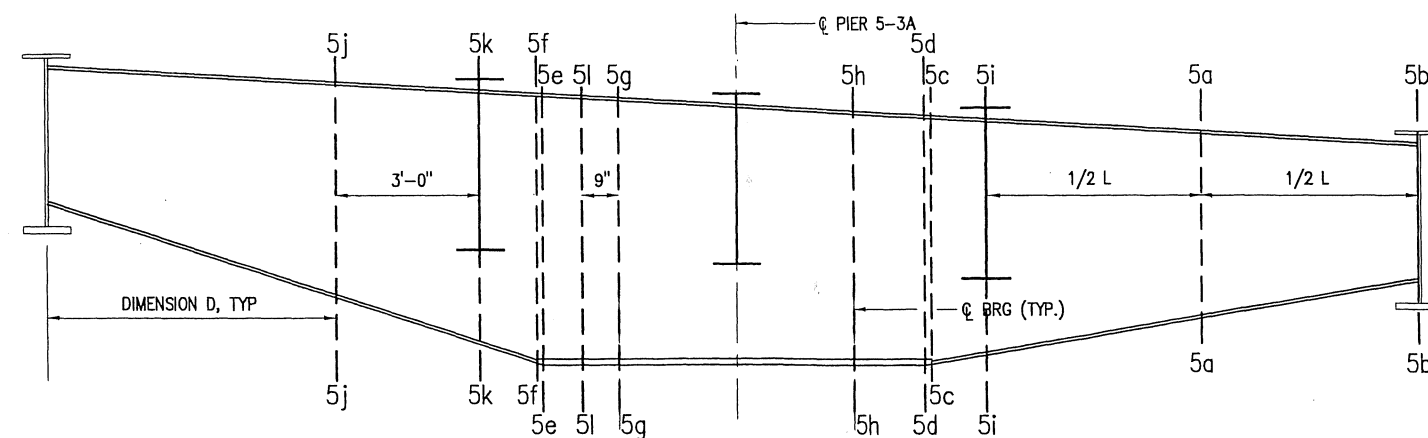


DIMENSION A	DIMENSION B
4a = 3'-0 5/8"	4a = 17'-2 3/8"
4b = 2'-3 1/2"	4b = 21'-3 7/16"
4c = 3'-5 5/8"	4c = 14'-11 7/8"
4d = 3'-6 11/16"	4d = 14'-6 3/16"
4e = 3'-9 3/4"	4e = 13'-1 1/2"
4f = 4'-0 1/2"	4f = 9'-0"
4g = 4'-1 1/16"	4g = 8'-2 1/4"
4h = 3'-11 3/8"	4h = 7'-6 3/16"
4i = 3'-10 7/16"	4i = 7'-1 7/8"
4j = 3'-11 3/8"	4j = 10'-7 7/8"
4k = 3'-7 3/8"	4k = 6'-0"



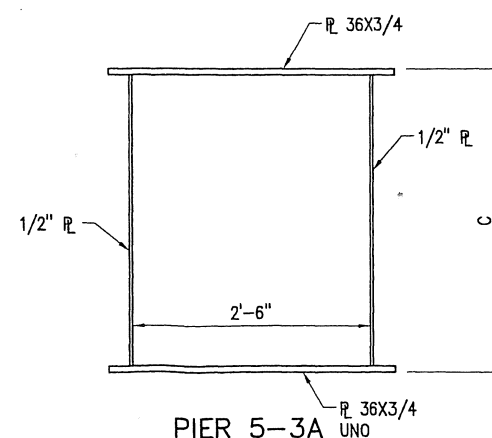
PIER 5-3A GEOMETRY

SCALE: 0 2'



PIER 5-3A SECTION CUTS

SCALE: 0 2'



DIMENSION C	DIMENSION D
5a = 3'-9 15/16"	5a = 24'-1 3/16"
5b = 2'-10 1/2"	5b = 28'-7 1/4"
5c = 5'-1 7/8"	5c = 18'-5 5/8"
5d = 5'-2 1/4"	5d = 18'-3 7/8"
5e = 5'-7 5/8"	5e = 10'-3 13/16"
5f = 5'-7 3/16"	5f = 10'-2 5/16"
5g = 5'-6 9/16"	5g = 11'-9 7/8"
5h = 5'-3 1/4"	5h = 16'-9 7/8"
5i = 4'-10 13/16"	5i = 19'-7 1/8"
5j = 4'-5 11/16"	5j = 6'-0"
5k = 5'-3 5/16"	5k = 9'-0"
5l = 5'-7 1/8"	5l = 11'-0 7/8"

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

NAME: _____ LIC. NO. _____ DATE: _____

TITLE: STEEL CAP BEAM
PIER 4 AND PIER 5 BRIDGE 3A

DES: _____ DR: CUM
CHK: _____ CHK: _____
APPROVED: _____
Sheet No. _____ of _____ Sheets

Bridge No. 69801

D-7

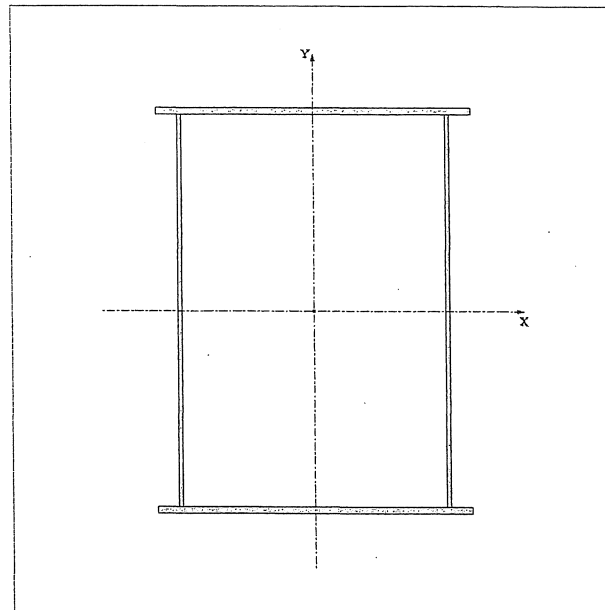
5/11/10

Section Properties: BR3A-5a

Number of Shapes	=	4	
Total Width	=	36.000	in
Total Height	=	45.938	in
Center, Xo	=	0.000	in
Center, Yo	=	0.000	in
X-bar(Right)	=	18.000	in
X-bar(Left)	=	18.000	in
Y-bar(Top)	=	22.969	in
Y-bar(Bot)	=	22.969	in

Equivalent Properties:

Area, Ax	=	98.438	in^2
Inertia, Ixx	=	3.488E+004	in^4
Inertia, Iyy	=	1.617E+004	in^4
Inertia, Ixy	=	0.000	in^4
Modulus, Sx(Top)	=	1518.63	in^3
Modulus, Sx(Bot)	=	1518.63	in^3
Modulus, Sy(Left)	=	898.20	in^3
Modulus, Sy(Right)	=	898.20	in^3
Radius, rx	=	18.824	in
Radius, ry	=	12.816	in
Plastic Modulus, Zx	=	1713.74	in^3
Plastic Modulus, Zy	=	1163.68	in^3
Torsional, J	=	13.740	in^4



Section Diagram

Section Used in Risa 3D model
 of Beam Cap

Company : LHB
 Designer : jdf
 Job Number: 090147

Feb 2, 2010
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 Checked By: CJM

S/11/10

Basic Properties of Shapes in Section: BR3A-5a (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	36.000	36.000	0.500	0.500
Height (in)	0.750	0.750	44.438	44.438
Xo (in)	0.000	0.000	-15.250	15.250
Yo (in)	22.594	-22.594	0.000	0.000
Ax (in^2)	27.000	27.000	22.219	22.219
Ixx (in^4)	1.266	1.266	3656.39	3656.39
Iyy (in^4)	2916.00	2916.00	0.463	0.463

Additional Properties of Shapes in Section: BR3A-5a (Local Axis, for n=1)

Sx-Top (in^3)	3.375	3.375	164.56	164.56
Sy-Right (in^3)	162.00	162.00	1.852	1.852
rx (in)	0.217	0.217	12.828	12.828
ry (in)	10.392	10.392	0.144	0.144
Zx (in^3)	5.063	5.063	246.84	246.84
Zy (in^3)	243.00	243.00	2.777	2.777
J (in^4)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

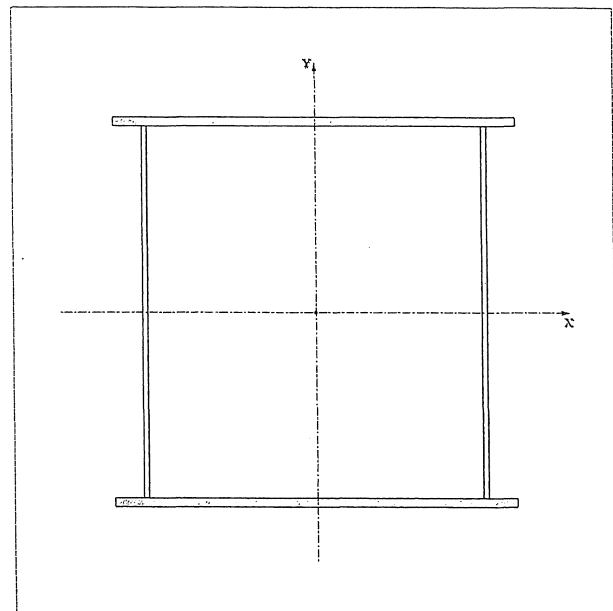
Q-9

Section Properties: BR3A-5b

Number of Shapes	=	4	
Total Width	=	36.000	in
Total Height	=	34.500	in
Center, Xo	=	0.000	in
Center, Yo	=	0.000	in
X-bar(Right)	=	18.000	in
X-bar(Left)	=	18.000	in
Y-bar(Top)	=	17.250	in
Y-bar(Bot)	=	17.250	in

Equivalent Properties:

Area, Ax	=	87.000	in^2
Inertia, Ixx	=	1.837E+004	in^4
Inertia, Iyy	=	1.351E+004	in^4
Inertia, Ixy	=	0.000	in^4
Modulus, Sx(Top)	=	1065.20	in^3
Modulus, Sx(Bot)	=	1065.20	in^3
Modulus, Sy(Left)	=	750.40	in^3
Modulus, Sy(Right)	=	750.40	in^3
Radius, rx	=	14.533	in
Radius, ry	=	12.460	in
Plastic Modulus, Zx	=	1183.50	in^3
Plastic Modulus, Zy	=	989.25	in^3
Torsional, J	=	12.785	in^4



Section Diagram

$$Wt = 87 \text{ in}^2 \div (12 \text{ in})^2 \times 490 \text{ pcf} \times 1.2 = 355 \text{ pcf}$$

0.1 for stiffeners }
 0.1 for other }

Company : LHB
 Designer : jdf
 Job Number: 090147

Feb 2, 2010
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 Checked By: CJM
S/111 5

Basic Properties of Shapes in Section: BR3A-5b (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	36.000	36.000	0.500	0.500
Height (in)	0.750	0.750	33.000	33.000
Xo (in)	0.000	0.000	-15.250	15.250
Yo (in)	16.875	-16.875	0.000	0.000
Ax (in^2)	27.000	27.000	16.500	16.500
Ixx (in^4)	1.266	1.266	1497.38	1497.38
Iyy (in^4)	2916.00	2916.00	0.344	0.344

Additional Properties of Shapes in Section: BR3A-5b (Local Axis, for n=1)

Sx-Top (in^3)	3.375	3.375	90.750	90.750
Sy-Right (in^3)	162.00	162.00	1.375	1.375
rx (in)	0.217	0.217	9.526	9.526
ry (in)	10.392	10.392	0.144	0.144
Zx (in^3)	5.063	5.063	136.13	136.13
Zy (in^3)	243.00	243.00	2.063	2.063
J (in^4)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

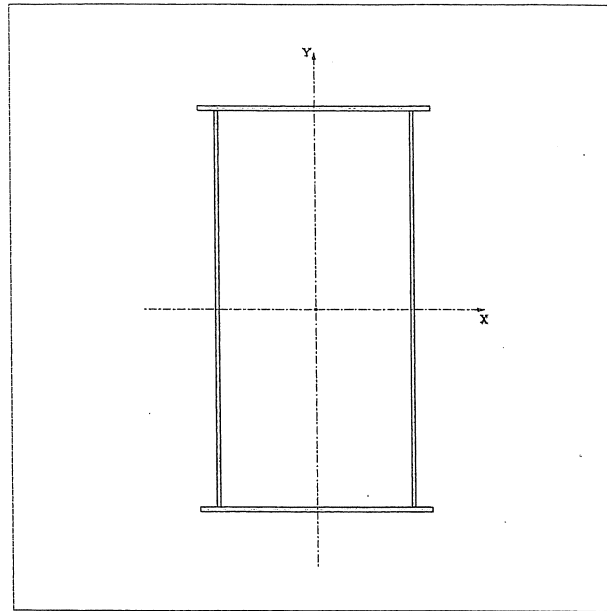
Q-11

Section Properties: BR3A-5c

Number of Shapes	=	4	
Total Width	=	36.000	in
Total Height	=	61.875	in
Center, Xo	=	0.000	in
Center, Yo	=	0.000	in
X-bar(Right)	=	18.000	in
X-bar(Left)	=	18.000	in
Y-bar(Top)	=	30.938	in
Y-bar(Bot)	=	30.938	in

Equivalent Properties:

Area, Ax	=	114.38	in^2
Inertia, Ixx	=	6.878E+004	in^4
Inertia, Iyy	=	1.987E+004	in^4
Inertia, Ixy	=	0.000	in^4
Modulus, Sx(Top)	=	2223.25	in^3
Modulus, Sx(Bot)	=	2223.25	in^3
Modulus, Sy(Left)	=	1104.12	in^3
Modulus, Sy(Right)	=	1104.12	in^3
Radius, rx	=	24.523	in
Radius, ry	=	13.182	in
Plastic Modulus, Zx	=	2561.66	in^3
Plastic Modulus, Zy	=	1406.72	in^3
Torsional, J	=	15.071	in^4



Section Diagram

$$W_t = 114.38 \text{ in}^2 \div 144 \text{ in}^2/\text{ft}^2 \times 490 \text{ pcf} \times 1.2 = 467 \text{ pcf} \checkmark$$

Company : LHB
 Designer : jdf
 Job Number: 090147

Feb 2, 2010
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 Checked By: *CSM*
5/11/10

Basic Properties of Shapes in Section: BR3A-5c (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	36.000	36.000	0.500	0.500
Height (in)	0.750	0.750	60.375	60.375
Xo (in)	0.000	0.000	-15.250	15.250
Yo (in)	30.563	-30.563	0.000	0.000
Ax (in^2)	27.000	27.000	30.188	30.188
Ixx (in^4)	1.266	1.266	9169.81	9169.81
Iyy (in^4)	2916.00	2916.00	0.629	0.629

Additional Properties of Shapes in Section: BR3A-5c (Local Axis, for n=1)

Sx-Top (in^3)	3.375	3.375	303.76	303.76
Sy-Right (in^3)	162.00	162.00	2.516	2.516
rx (in)	0.217	0.217	17.429	17.429
ry (in)	10.392	10.392	0.144	0.144
Zx (in^3)	5.063	5.063	455.64	455.64
Zy (in^3)	243.00	243.00	3.773	3.773
J (in^4)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

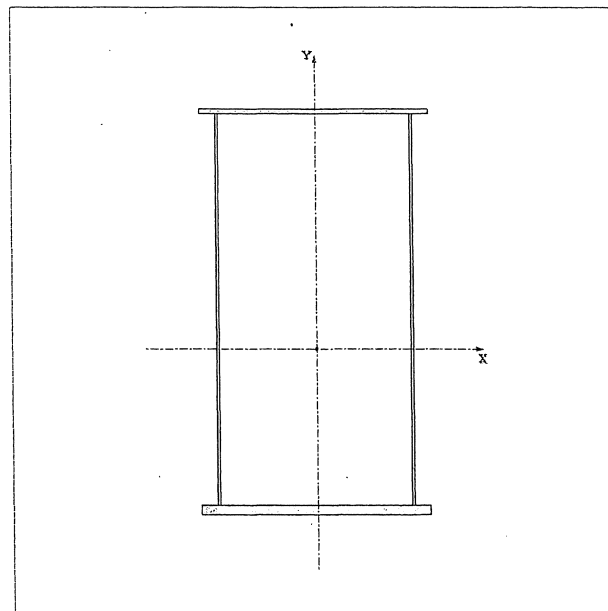
Q-13

Section Properties: BR3A-5d

Number of Shapes	=	4	
Total Width	=	36.000	in
Total Height	=	62.255	in
Center, Xo	=	0.000	in
Center, Yo	=	-5.587	in
X-bar(Right)	=	18.000	in
X-bar(Left)	=	18.000	in
Y-bar(Top)	=	36.712	in
Y-bar(Bot)	=	25.543	in

Equivalent Properties:

Area, Ax	=	141.00	in^2
Inertia, Ixx	=	8.899E+004	in^4
Inertia, Iyy	=	2.270E+004	in^4
Inertia, Ixy	=	0.000	in^4
Modulus, Sx(Top)	=	2423.94	in^3
Modulus, Sx(Bot)	=	3483.84	in^3
Modulus, Sy(Left)	=	1261.28	in^3
Modulus, Sy(Right)	=	1261.28	in^3
Radius, rx	=	25.122	in
Radius, ry	=	12.689	in
Plastic Modulus, Zx	=	3198.66	in^3
Plastic Modulus, Zy	=	1644.00	in^3
Torsional, J	=	49.681	in^4



Section Diagram

$$wt = 141 \times 490 \text{ pcf} \div (12 \text{ in})^2 \times 1.2 = 576 \text{ pcf} \quad \checkmark$$

Company : LHB
 Designer : jdf
 Job Number: 090147

Feb 2, 2010
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 Checked By: *CSH*
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Basic Properties of Shapes in Section: BR3A-5d (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	36.000	36.000	0.500	0.500
Height (in)	0.750	1.500	60.000	60.000
Xo (in)	0.000	0.000	-15.250	15.250
Yo (in)	30.750	-30.380	0.375	0.375
Ax (in^2)	27.000	54.000	30.000	30.000
Ixx (in^4)	1.266	10.125	9000.00	9000.00
Iyy (in^4)	2916.00	5832.00	0.625	0.625

Additional Properties of Shapes in Section: BR3A-5d (Local Axis, for n=1)

Sx-Top (in^3)	3.375	13.500	300.00	300.00
Sy-Right (in^3)	162.00	324.00	2.500	2.500
rx (in)	0.217	0.433	17.321	17.321
ry (in)	10.392	10.392	0.144	0.144
Zx (in^3)	5.063	20.250	450.00	450.00
Zy (in^3)	243.00	486.00	3.750	3.750
J (in^4)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

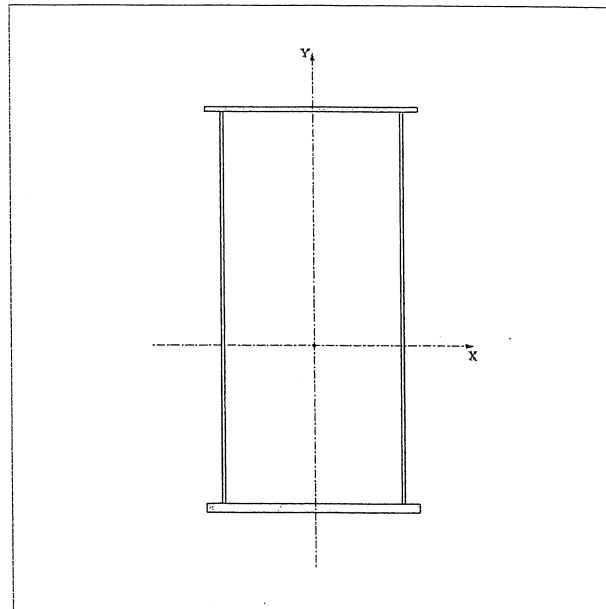
Q-15

Section Properties: BR3A-5e

Number of Shapes	=	4	
Total Width	=	36.000	in
Total Height	=	67.625	in
Center, Xo	=	0.000	in
Center, Yo	=	-5.860	in
X-bar(Right)	=	18.000	in
X-bar(Left)	=	18.000	in
Y-bar(Top)	=	39.672	in
Y-bar(Bot)	=	27.953	in

Equivalent Properties:

Area, Ax	=	146.38	in^2
Inertia, Ixx	=	1.075E+005	in^4
Inertia, Iyy	=	2.395E+004	in^4
Inertia, Ixy	=	-0.000	in^4
Modulus, Sx(Top)	=	2709.59	in^3
Modulus, Sx(Bot)	=	3845.61	in^3
Modulus, Sy(Left)	=	1330.73	in^3
Modulus, Sy(Right)	=	1330.73	in^3
Radius, rx	=	27.100	in
Radius, ry	=	12.792	in
Plastic Modulus, Zx	=	3584.54	in^3
Plastic Modulus, Zy	=	1725.97	in^3
Torsional, J	=	50.129	in^4



Section Diagram

$$wt = 146.38 \text{ in}^2 \div (12 \text{ in})^2 \times 490 \text{ pcf} \times 1.2 = 598 \text{ pcf} \quad \checkmark$$

Company : LHB
 Designer : jdf
 Job Number: 090147

Feb 2, 2010
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 Checked By: GJM
5/11/10

Basic Properties of Shapes in Section: BR3A-5e (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	36.000	36.000	0.500	0.500
Height (in)	0.750	1.500	65.375	65.375
Xo (in)	0.000	0.000	-15.250	15.250
Yo (in)	33.438	-33.063	0.380	0.380
Ax (in ²)	27.000	54.000	32.688	32.688
Ixx (in ⁴)	1.266	10.125	1.164E+004	1.164E+004
Iyy (in ⁴)	2916.00	5832.00	0.681	0.681

Additional Properties of Shapes in Section: BR3A-5e (Local Axis, for n=1)

Sx-Top (in ³)	3.375	13.500	356.16	356.16
Sy-Right (in ³)	162.00	324.00	2.724	2.724
rx (in)	0.217	0.433	18.872	18.872
ry (in)	10.392	10.392	0.144	0.144
Zx (in ³)	5.063	20.250	534.24	534.24
Zy (in ³)	243.00	486.00	4.086	4.086
J (in ⁴)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Company : LHB
 Designer : jdf
 Job Number: 090147

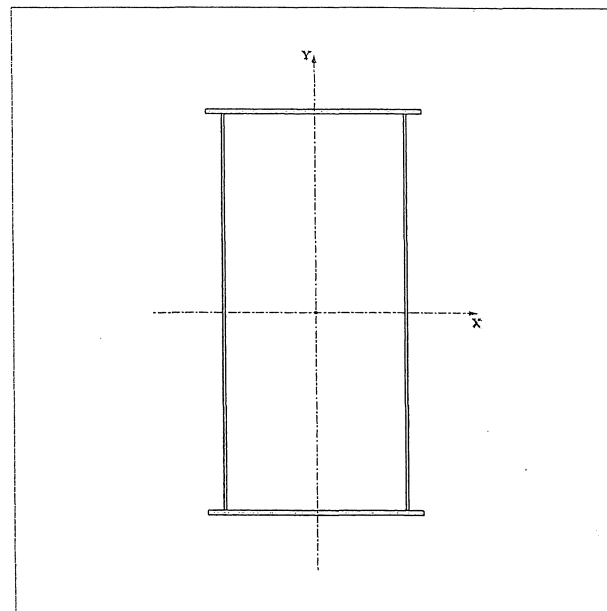
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 Checked By: GJM
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Section Properties: BR3A-5f

Number of Shapes	=	4	
Total Width	=	36.000	in
Total Height	=	67.188	in
Center, Xo	=	0.000	in
Center, Yo	=	0.000	in
X-bar(Right)	=	18.000	in
X-bar(Left)	=	18.000	in
Y-bar(Top)	=	33.594	in
Y-bar(Bot)	=	33.594	in

Equivalent Properties:

Area, Ax	=	119.69	in^2
Inertia, Ixx	=	8.321E+004	in^4
Inertia, Iyy	=	2.111E+004	in^4
Inertia, Ixy	=	0.000	in^4
Modulus, Sx(Top) <i>tension</i>	=	2476.95	in^3
Modulus, Sx(Bot) <i>comp</i>	=	2476.95	in^3
Modulus, Sy(Left)	=	1172.77	in^3
Modulus, Sy(Right)	=	1172.77	in^3
Radius, rx	=	26.367	in
Radius, ry	=	13.281	in
Plastic Modulus, Zx	=	2872.53	in^3
Plastic Modulus, Zy	=	1487.73	in^3
Torsional, J	=	15.514	in^4



Section Diagram

$$wt = 119.69 \text{ in}^2 \div (12 \text{ in})^2 \times 490 \text{ pcf} \times 1.2 = 489 \text{ pcf} \checkmark$$

Company : LHB
 Designer : jdf
 Job Number: 090147

Feb 2, 2010
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 Checked By: *COM*
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Basic Properties of Shapes in Section: BR3A-5f (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	36.000	36.000	0.500	0.500
Height (in)	0.750	0.750	65.688	65.688
Xo (in)	0.000	0.000	-15.250	15.250
Yo (in)	33.219	-33.219	0.000	0.000
Ax (in ²)	27.000	27.000	32.844	32.844
Ixx (in ⁴)	1.266	1.266	1.181E+004	1.181E+004
Iyy (in ⁴)	2916.00	2916.00	0.684	0.684

Additional Properties of Shapes in Section: BR3A-5f (Local Axis, for n=1)

Sx-Top (in ³)	3.375	3.375	359.57	359.57
Sy-Right (in ³)	162.00	162.00	2.737	2.737
rx (in)	0.217	0.217	18.962	18.962
ry (in)	10.392	10.392	0.144	0.144
Zx (in ³)	5.063	5.063	539.36	539.36
Zy (in ³)	243.00	243.00	4.105	4.105
J (in ⁴)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Company : LHB
 Designer : jdf
 Job Number: 090147

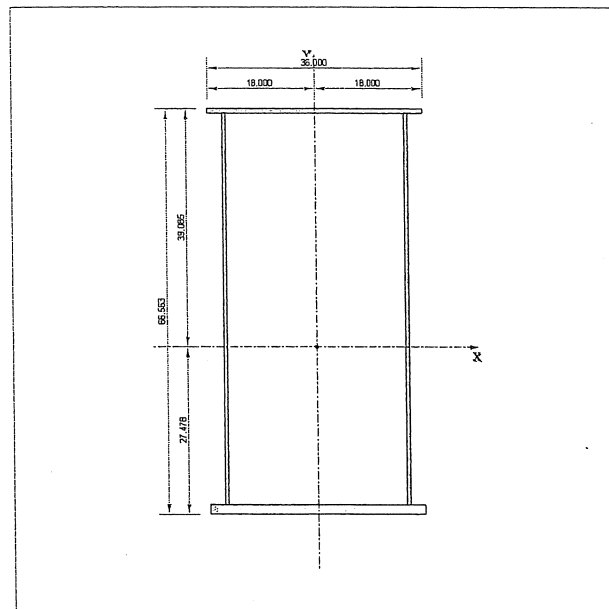
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 Checked By: *QJM*
5/11/10

Section Properties: BR3A-5g

Number of Shapes	=	4	
Total Width	=	36.000	in
Total Height	=	66.563	in
Center, Xo	=	-0.000	in
Center, Yo	=	-6.441	in
X-bar(Right)	=	18.000	in
X-bar(Left)	=	18.000	in
Y-bar(Top) <i>ten</i>	=	39.085	in
Y-bar(Bot) <i>comp</i>	=	27.478	in

Equivalent Properties:

Area, Ax	=	145.31	in^2
Inertia, Ixx	=	1.037E+005	in^4
Inertia, Iyy	=	2.371E+004	in^4
Inertia, Ixy	=	-0.024	in^4
Modulus, Sx(Top) <i>ten</i>	=	2652.65	in^3
Modulus, Sx(Bot) <i>comp</i>	=	3773.13	in^3
Modulus, Sy(Left)	=	1317.01	in^3
Modulus, Sy(Right)	=	1317.00	in^3
Radius, rx	=	26.711	in
Radius, ry	=	12.773	in
Plastic Modulus, Zx	=	3507.41	in^3
Plastic Modulus, Zy	=	1709.77	in^3
Torsional, J	=	50.040	in^4



Section Diagram

Company : LHB
 Designer : jdf
 Job Number: 090147

Feb 4, 2010
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 Checked By: CSM
5/11/10

Basic Properties of Shapes in Section: BR3A-5g (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	36.000	36.000	0.500	0.500
Height (in)	0.750	1.500	64.313	64.313
Xo (in)	0.000	0.000	-15.250	15.250
Yo (in)	32.269	-33.169	-0.250	-0.250
Ax (in^2)	27.000	54.000	32.157	32.156
Ixx (in^4)	1.266	10.125	1.108E+004	1.108E+004
Iyy (in^4)	2916.00	5832.00	0.670	0.670

Additional Properties of Shapes in Section: BR3A-5g (Local Axis, for n=1)

Sx-Top (in^3)	3.375	13.500	344.68	344.67
Sy-Right (in^3)	162.00	324.00	2.680	2.680
rx (in)	0.217	0.433	18.566	18.565
ry (in)	10.392	10.392	0.144	0.144
Zx (in^3)	5.063	20.250	517.02	517.01
Zy (in^3)	243.00	486.00	4.020	4.020
J (in^4)	1.#IOE+000	0.000E+000	0.000E+000	0.000E+000

Company : LHB
 Designer : jdf
 Job Number: 090147

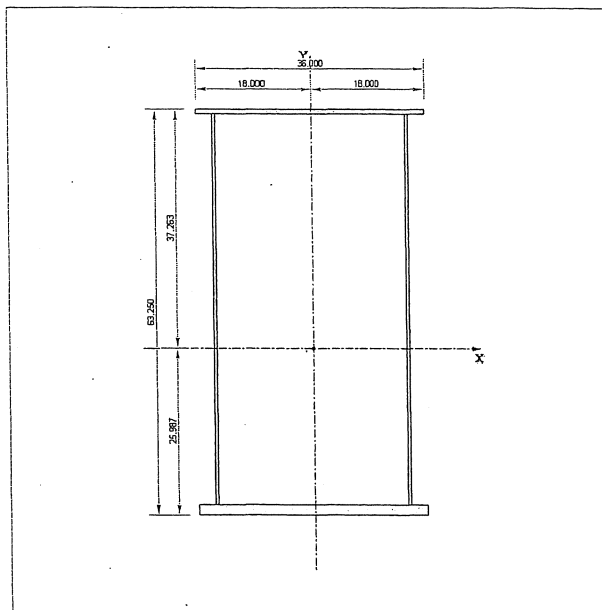
Feb 4, 2010
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 Checked By: CTM
5/11/10

Section Properties: BR3A-5h

Number of Shapes	=	4	
Total Width	=	36.000	in
Total Height	=	63.250	in
Center, Xo	=	0.000	in
Center, Yo	=	-6.013	in
X-bar(Right)	=	18.000	in
X-bar(Left)	=	18.000	in
Y-bar(Top)	=	37.263	in
Y-bar(Bot)	=	25.987	in

Equivalent Properties:

Area, Ax	=	142.00	in ²
Inertia, Ixx	=	9.226E+004	in ⁴
Inertia, Iyy	=	2.294E+004	in ⁴
Inertia, Ixy	=	0.000	in ⁴
Modulus, Sx(Top)	=	2476.02	in ³
Modulus, Sx(Bot)	=	3550.44	in ³
Modulus, Sy(Left)	=	1274.20	in ³
Modulus, Sy(Right)	=	1274.20	in ³
Radius, rx	=	25.490	in
Radius, ry	=	12.709	in
Plastic Modulus, Zx	=	3269.13	in ³
Plastic Modulus, Zy	=	1659.25	in ³
Torsional, J	=	49.764	in ⁴



Section Diagram

Company : LHB
 Designer : jdf
 Job Number: 090147

Feb 4, 2010
 12:56 PM
 Checked By: CSM

5/11/10

Basic Properties of Shapes in Section: BR3A-5h (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	36.000	36.000	0.500	0.500
Height (in)	0.750	1.500	61.000	61.000
Xo (in)	0.000	0.000	-15.250	15.250
Yo (in)	30.875	-31.250	0.000	0.000
Ax (in^2)	27.000	54.000	30.500	30.500
Ixx (in^4)	1.266	10.125	9457.54	9457.54
Iyy (in^4)	2916.00	5832.00	0.635	0.635

Additional Properties of Shapes in Section: BR3A-5h (Local Axis, for n=1)

Sx-Top (in^3)	3.375	13.500	310.08	310.08
Sy-Right (in^3)	162.00	324.00	2.542	2.542
rx (in)	0.217	0.433	17.609	17.609
ry (in)	10.392	10.392	0.144	0.144
Zx (in^3)	5.063	20.250	465.13	465.13
Zy (in^3)	243.00	486.00	3.813	3.813
J (in^4)	0.000E+000	0.000E+000	0.000E+000	0.000E+000

Q-23

Company : LHB
 Designer : jdf
 Job Number: 090147

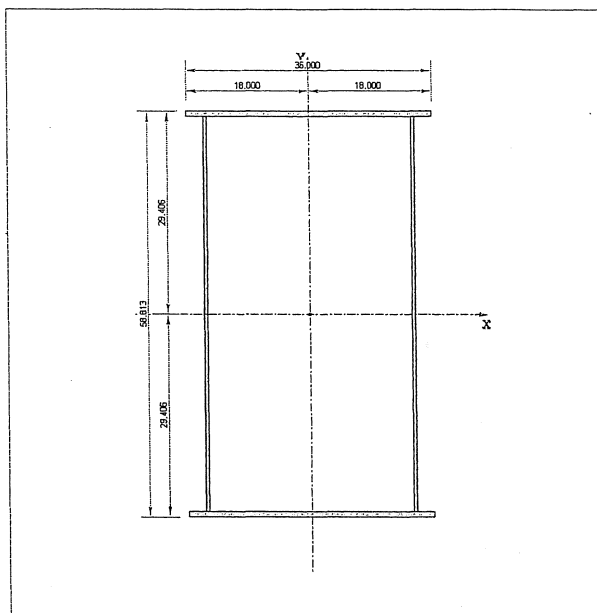
Feb 10, 2010
 13:27 PM
 Checked By: 65M
5/11/10

Section Properties: BR3A-5i

Number of Shapes	=	4	
Total Width	=	36.000	in
Total Height	=	58.813	in
Center, Xo	=	0.000	in
Center, Yo	=	0.000	in
X-bar(Right)	=	18.000	in
X-bar(Left)	=	18.000	in
Y-bar(Top)	=	29.406	in
Y-bar(Bot)	=	29.406	in

Equivalent Properties:

Area, Ax	=	111.31	in ²
Inertia, Ixx	=	6.120E+004	in ⁴
Inertia, Iyy	=	1.916E+004	in ⁴
Inertia, Ixy	=	0.000	in ⁴
Modulus, Sx(Top)	=	2081.27	in ³
Modulus, Sx(Bot)	=	2081.27	in ³
Modulus, Sy(Left)	=	1064.55	in ³
Modulus, Sy(Right)	=	1064.55	in ³
Radius, rx	=	23.448	in
Radius, ry	=	13.120	in
Plastic Modulus, Zx	=	2388.87	in ³
Plastic Modulus, Zy	=	1360.02	in ³
Torsional, J	=	14.815	in ⁴



Section Diagram

Company : LHB
Designer : jdf
Job Number: 090147

Feb 10, 2010
13:27 PM
Checked By: CSM
Stille

Basic Properties of Shapes in Section: BR3A-5i (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	36.000	36.000	0.500	0.500
Height (in)	0.750	0.750	57.313	57.313
Xo (in)	0.000	0.000	-15.250	15.250
Yo (in)	29.031	-29.031	0.000	0.000
Ax (in ²)	27.000	27.000	28.656	28.656
Ixx (in ⁴)	1.266	1.266	7843.99	7843.99
Iyy (in ⁴)	2916.00	2916.00	0.597	0.597

Additional Properties of Shapes in Section: BR3A-5i (Local Axis, for n=1)

Sx-Top (in ³)	3.375	3.375	273.73	273.73
Sy-Right (in ³)	162.00	162.00	2.388	2.388
rx (in)	0.217	0.217	16.545	16.545
ry (in)	10.392	10.392	0.144	0.144
Zx (in ³)	5.063	5.063	410.59	410.59
Zy (in ³)	243.00	243.00	3.582	3.582
J (in ⁴)	5.024	5.024	2.384	2.384



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PROJECT MnDOT SS-69801 3A-P5, Pinned or Fixed
PROJECT # 090147 DATE 11/9/09 BY jdf SHEET NO. 5/11/10 OF 5/11/10

Are the beam to pier cap and pier cap to pier connections fixed, pinned, or partially restrained?

Interior and exterior beam to pier cap connections have been designed for shear only, no moment. ✓

Pier Cap to Pier connections are made with curved shoes to allow rotation in the longitudinal direction but are spaced 5' apart to restrain transverse loads. ✓

Beam calcs show typical continuous beam with pinned supports. ✓



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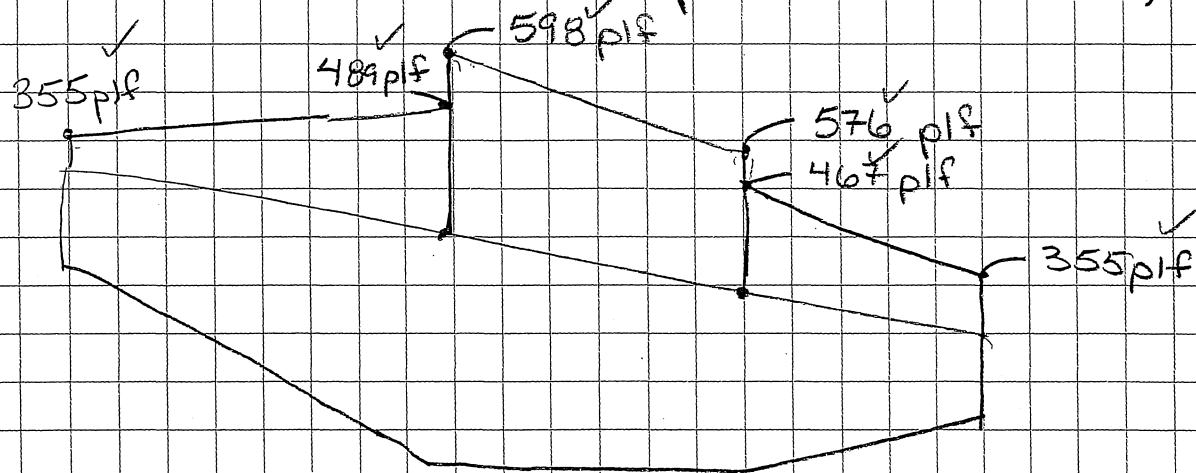
PROJECT Mn DOT-BR69801 3A-P5 - Cap Beam Self weight

PROJECT # 090147 DATE 12/16/09 BY jdf SHEET NO. 1 OF 1

Determine the Cap Beam's Self wt.

Wt of Cap varies along it's length.

Determine weight by taking section weight and multiplying by 1.2 (0.1 is for stiffeners and 0.1 is for other plates and fasteners)!



See Section properties sheets from Risa Section for weight computations.



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PROJECT MnDOT SS-69801 - Centrifugal Forces - LRFD - 1
PROJECT # 090147 DATE 1/12/09 BY jaf SHEET NO. _____ OF _____
Wsm 5/4/10

Determine Centrifugal forces on pier cap.
See 3.6.3

$$C = f \frac{V^2}{gR}$$

C = Factor to apply to axle weight of the design truck or tandem.

f = $\frac{4}{3}$ for local comb. other than fatigue

V = design speed (ft/sec)

g = 32.2 ft/sec²

R = Radius of curvature (ft).

P2-3E ✓

S = 30 mph ✓ See WJS calcs 12-7-09 = 40 ft/sec

R = 254.25' ✓

$$C = \frac{4}{3} \times \frac{40^2}{32.2 \times 254.25} = \boxed{0.26}^{1.32}$$

P4-3A

S = 40 mph = 58.7 ft/sec ✓

R = 473.7' ✓

$$\boxed{C = 0.30} \checkmark$$

P5-3A

S = 50 mph = 73.3 ft/sec ✓

R = 826.26' ✓

$$\boxed{C = 0.27} \checkmark$$

P6-3A

S = 50 mph = 73.3 ft/sec ✓

R = 826.26' ✓

$$\boxed{C = 0.27} \checkmark$$



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PROJECT MnDOT SS-69801J - P5-3A - Centrifugal Forces - 1

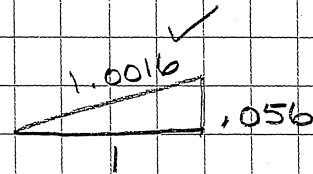
PROJECT # 090147 DATE 1/19/2010 BY jdf ^{✓com} _{5/11/10} SHEET NO. _____ OF _____

$$S = 50 \text{ mph} \checkmark$$

$$R = 826.26' \checkmark$$

$$C = 0.27 \checkmark$$

$$\text{Superelevation} = 0.056 \text{ ft/ft} \checkmark$$



$$\text{CF balanced by Superelevation} = 0.27 - 0.056 = 0.214 \checkmark$$

$$\text{Controlling Reaction at pier} = 2 \times 71.3 = 142.6 \text{ k} \checkmark$$

✓ 2 lanes
↓ truck

$$\text{Total CF Load} = 0.214 \times 142.6 = 30.5 \text{ k}$$

Distribute by "Pile group distribution"

I supports $\Rightarrow$

NA from Beam F:

$$\frac{9.05 + 14.34 + 19.64 + 28.64}{5} = 14.33' \checkmark$$

$$I = 14.33^2 + (14.33 - 9.05)^2 + (14.34 - 14.33)^2 + (19.64 - 14.33)^2 + (28.64 - 14.33)^2 = 466.2 \text{ ft}^2 \checkmark$$

$$\begin{aligned} \text{Moment arm} &= 6' \times 1.0016 \\ &+ .67' \\ &+ .5' \\ &+ \frac{1}{2} \times 5.41' \\ &= 9.88' \checkmark \end{aligned}$$

6' above slab
slab depth
bot slab + T/cap
1/2 cap beam depth

$$P \downarrow @ \text{ beam A} = 30.5 \text{ k} \times 9.88' \times (28.64 - 14.33) \div 466.2 = 9.25 \text{ k} \checkmark$$

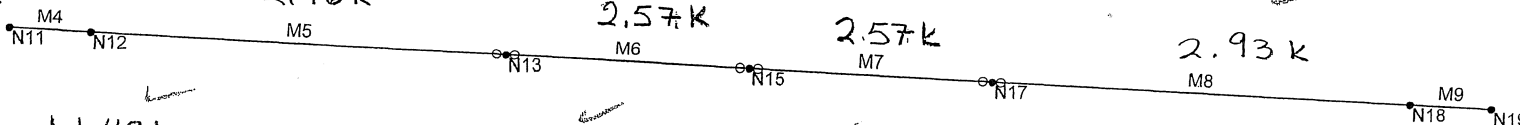
$$P \downarrow @ \text{ beam B} = 30.5 \text{ k} \times 9.88' \times (19.64 - 14.33) \div 466.2 = 3.43 \text{ k}$$

$P \downarrow @ \text{ beams D, E, \& F} = 0 \text{ k}$ as can't get uplift

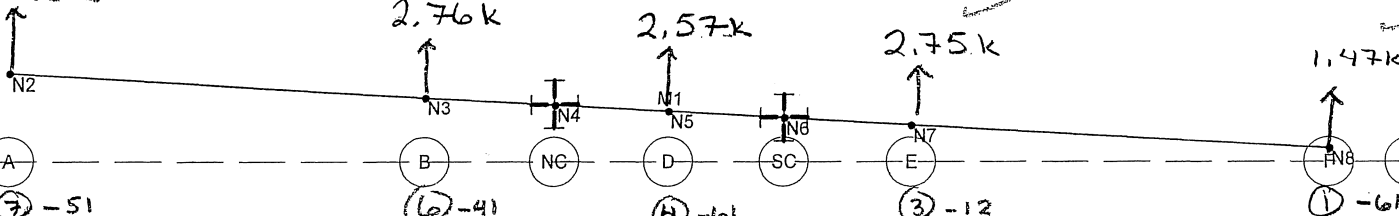
$$P \leftarrow \text{at each beam @ 4 of cap beam} = 30.5 \div 5 = 6.1 \text{ k} \checkmark$$



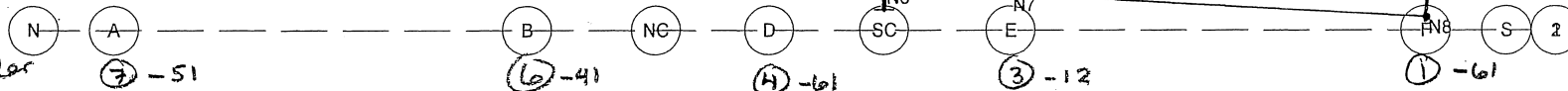
MDX
Bracing
Load →



Risa Pt Load 1.48k
to Counteract
MDX Load



MDX girder
and brace #



1/5m
5/11/10

LHB

jdf

090147

Bridge 69801 3A Pier 5 With Girder D

MDX Bracing Loads

Jan 19, 2010 at 11:31 AM

090147_3A_P5_WGirderD.r3d

02-30



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PROJECT MnDOT SS-69801 J - P5-3A - Braking Force -1

PROJECT # 090147 DATE 1/22/2010 BY jdf ^{CSM}
SHEET NO. _____ OF _____
5/11/10

Determine Braking Force for Pier 5 of 3A.
Both Pier 5 and Pier 6 are fixed for these spans between expansion joints. Therefore we will need to approximate the relative stiffnesses of these piers to distribute the force accordingly.

For Pier 5, Truck load + lane controls strong axis bending
For Pier 6, $0.9 \times (2 \text{ trucks @ } 50') + 0.9 \text{ Lane controls strong axis bending.}$

See Pier 6 for Braking Force to be distributed for pier 6 design.

Force @ Pier 5 is the greater of: (per lane).

1) 25% of axle weight of the design trucks.

$$= .25 \times (8 + 32 + 32) = 18 \text{ kip} \checkmark$$

2) 5% of the design truck plus 5% of the design lane

$$= 0.05(8 + 32 + 32) + 0.05 \times .640 \text{ Klf} \times 181.9' = 9.4 \text{ kip} \checkmark$$

* Distance between expansion joints =
 $(8'-0") + (82'-7\frac{9}{16}") + (22'-4\frac{3}{16}") + (60'-7\frac{1}{2}") + (8'-0")$
 $= 181.9' \checkmark$ ← conservative, but doesn't control anyway.

Total Braking Force = 2 lanes $\times$ 18 kip = 36 kip $\checkmark$
to be split between Piers 5 & 6.



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PROJECT MnDOT SS-69801J-P5-3A - Braking Force -2

PROJECT # 090147 DATE 1/22/2010 BY jdf SHEET NO. 511010 OF 511010

Pier 5 is a steel "hammer" shaped beam cap which is hinged to the concrete pier in the longitudinal direction.

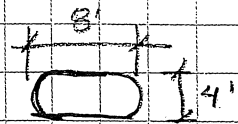
Avg T/slab elev = 641.54' ✓ ← see original drawing sheet 137

T/slab now = 641.54' + 1 1/2" ÷ 12" = 641.66' ✓
↑ added 1 1/2" when resurfaced

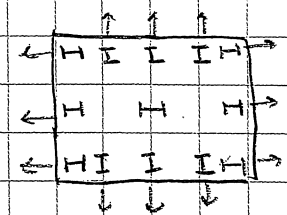
T/conc pier = 634.42' ✓
T/ftg = 604.00' ✓
B/ftg = 600.00' ✓

} sheet 53

Pier is a 8'-0" x 4'-0" elongated circle



Footing is 19' x 17' x 4' w/ (13) piles ✓
piles are 125' deep and battered along the exterior.



T/pier to T/ftg = 30.42' ✓

↑ use this due to hinge @ top of pier

N ←



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PROJECT MnDOT SS-69801J-P5-3A-Braking Force -3
PROJECT # 090147 DATE 1/22/2010 BY jdf SHEET NO. 1/5 OF 5

Pier 6 is a steel box beam girder cap which is hinged to the concrete pier in the longitudinal direction.

$$\text{Avg T/slab elev} = \frac{1}{2}(644.23 + 644.02) = 644.12' \checkmark$$

(see original drawing sheet 137)

$$\text{T/slab now} = 644.12 + 1\frac{1}{2}" \div 12" = 644.24' \checkmark$$

Added 1 1/2" when resurfaced

Top / conc pier $\Rightarrow$ varies, N is 637.75', S is 634.59'
 Use avg of 636.2' $\checkmark$

$$\text{Top / ftg} = 602.00' \checkmark$$

$$\text{Bottom of ftg} = 598'.00' \checkmark$$

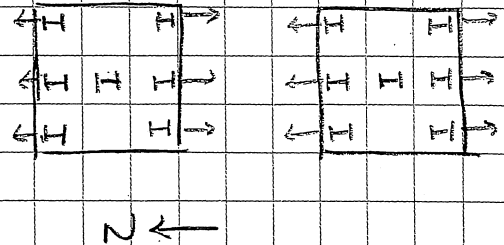
see sheet 53

There are two piers (one on each end of the box girder)
Each is 4'-0" ϕ

Footings are each 12' x 12' x 4'-0" $\checkmark$
w/ (7) piles, 125' deep. + battered $\checkmark$
in the N-S direction

$$\text{T/pier to T/ftg} = 34.2' \checkmark$$

use this due to hinge at top of pier





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PROJECT MnDOT SS-69801J - P5-3A - Braking Force -4
PROJECT # 090147 DATE 1/22/2010 BY jdF SHEET NO. 15m OF 511110

Determine stiffness coefficients for Piers 5+6

Pier 5:

(7) piles $\perp$ to traffic and (6) piles $\parallel$ to traffic.

$$\beta_{\perp} D = .119 \times 125 = 14.9$$

$$\beta_{\parallel} D = .090 \times 125 = 11.3$$

See P4-3A Braking Forces for additional information.

$$\Delta a_{\perp} = \frac{14.9 \times P_a}{2560} = .00582 P_a \Rightarrow \frac{P_a}{\Delta a_{\perp}} = 171.8 \text{ kip/foot}$$

$$\Delta a_{\parallel} = \frac{11.3 \times P_a}{2560} = .00441 P_a \Rightarrow \frac{P_a}{\Delta a_{\parallel}} = 226.8 \text{ kip/foot}$$

$$\text{Pier 5 } K = 7 \times 171.8 \text{ k/ft} + 6 \times 226.8 \text{ k/ft} = 2651.6 \text{ kip/ft} = 221.0 \text{ kip/in}$$

Pier 6:

(7) piles per footing, all $\perp$ to traffic

$$\text{Pier 6 } K = 7 \times 171.8 \text{ k/ft} = 1202.6 \text{ k/ft} = 100.2 \text{ kip/in}$$

Model the piers & pile caps in Risa and apply a 1 kip longitudinal force

P5-3A takes 65.3%	P5-3A = 62.3%
P6-3A takes 34.7%	P6-3A = 40.7%

of the 1 kip load.

Use these percentages to apply braking force

$$\text{P5-3A Braking Force} = .653 \times 36 \text{ k} = 23.5 \text{ kip}$$

$$\text{Bridge Deck width} = 32.14' \quad W = 23.5 \text{ k} / 32.14' = 0.731 \text{ k/ft}$$

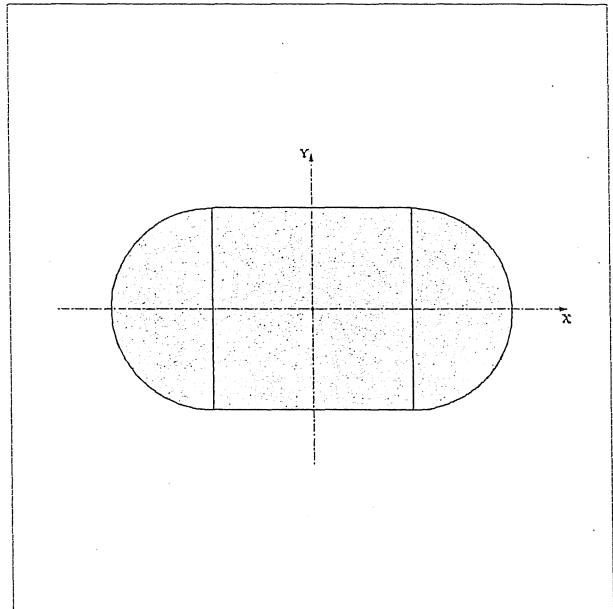
Torsion in pier cap is not considered as pier cap is allowed to Rotate in the longitudinal direction. Q-34

Section Properties: P5-3A-Pier

Number of Shapes	=	3	
Total Width	=	96.000	in
Total Height	=	48.000	in
Center, Xo	=	-8.000	in
Center, Yo	=	1.230	in
X-bar(Right)	=	48.000	in
X-bar(Left)	=	48.000	in
Y-bar(Top)	=	24.000	in
Y-bar(Bot)	=	24.000	in

Equivalent Properties:

Area, Ax	=	4104.38	in^2
Inertia, Ixx	=	7.003E+005	in^4
Inertia, Iyy	=	2.615E+006	in^4
Inertia, Ixy	=	0.069	in^4
Modulus, Sx(Top)	=	2.918E+004	in^3
Modulus, Sx(Bot)	=	2.918E+004	in^3
Modulus, Sy(Left)	=	5.449E+004	in^3
Modulus, Sy(Right)	=	5.449E+004	in^3
Radius, rx	=	13.062	in
Radius, ry	=	25.243	in
Plastic Modulus, Zx	=	4.592E+004	in^3
Plastic Modulus, Zy	=	8.913E+004	in^3
Torsional, J	=	9.435E+005	in^4



Section Diagram

Company : LHB
Designer : jdf
Job Number: 090147

Jan 22, 2010

16:56 PM

Checked By: CJM
5/11/10

Basic Properties of Shapes in Section: P5-3A-Pier (Local Axis, for n=1)

Sh.No.	1	2	3
Shape	Rectangular	Semi Circle	Semi Circle
Ratio(n)	0.103	0.103	0.103
Width (in)	48.000	24.000	24.000
Height (in)	48.000	48.000	48.000
Xo (in)	-8.000	-42.160	26.160
Yo (in)	1.230	1.230	1.230
Ax (in ²)	2304.00	900.19	900.19
Ixx (in ⁴)	4.424E+005	3.605E+004	3.605E+004
Iyy (in ⁴)	4.424E+005	1.290E+005	1.290E+005

Additional Properties of Shapes in Section: P5-3A-Pier (Local Axis, for n=1)

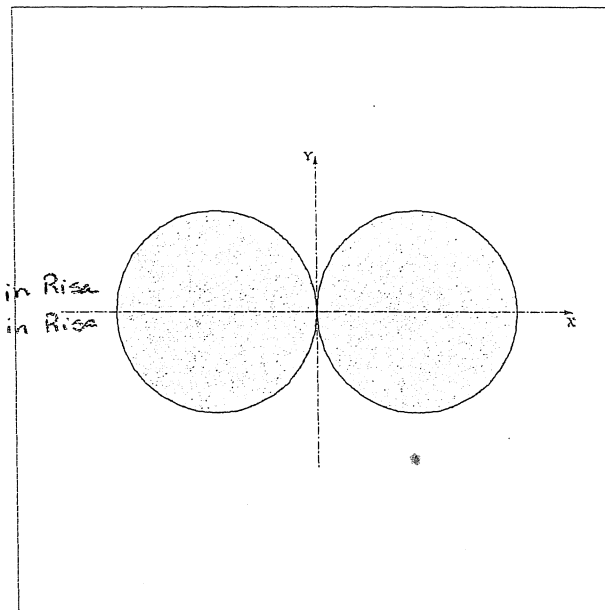
Sx-Top (in ³)	1.843E+004	2604.60	2604.60
Sy-Right (in ³)	1.843E+004	5373.80	5373.80
rx (in)	13.856	6.328	6.328
ry (in)	13.856	11.970	11.970
Zx (in ³)	2.765E+004	4850.54	4850.54
Zy (in ³)	2.765E+004	9134.42	9134.42
J (in ⁴)	7.478E+005	9.784E+004	9.784E+004

Section Properties: P6-3A-Pier

Number of Shapes	=	2	
Total Width	=	96.000	in
Total Height	=	48.000	in
Center, Xo	=	0.759	in
Center, Yo	=	-0.759	in
X-bar(Right)	=	48.000	in
X-bar(Left)	=	48.000	in
Y-bar(Top)	=	24.000	in
Y-bar(Bot)	=	24.000	in

Equivalent Properties:

Area, Ax	=	3619.11	in^2
Inertia, Ixx	=	5.212E+005	in^4
Inertia, Iyy	=	2.606E+006	in^4
Inertia, Ixy	=	0.016	in^4
Modulus, Sx(Top)	=	2.171E+004	in^3
Modulus, Sx(Bot)	=	2.171E+004	in^3
Modulus, Sy(Left)	=	5.429E+004	in^3
Modulus, Sy(Right)	=	5.429E+004	in^3
Radius, rx	=	12.000	in
Radius, ry	=	26.833	in
Plastic Modulus, Zx	=	3.645E+004	in^3
Plastic Modulus, Zy	=	8.628E+004	in^3
Torsional, J	=	1.042E+006	in^4



Section Diagram

Company : LHB
Designer : jdf
Job Number: 090147

Jan 22, 2010
16:56 PM
Checked By: CSM
5/11/10

Basic Properties of Shapes in Section: P6-3A-Pier (Local Axis, for n=1)

Sh.No.	1	2
Shape	Circular	Circular
Ratio(n)	0.103	0.103
Width (in)	48.000	48.000
Height (in)	48.000	48.000
Xo (in)	-23.241	24.759
Yo (in)	-0.759	-0.759
Ax (in^2)	1809.56	1809.56
Ixx (in^4)	2.606E+005	2.606E+005
Iyy (in^4)	2.606E+005	2.606E+005

Additional Properties of Shapes in Section: P6-3A-Pier (Local Axis, for n=1)

Sx-Top (in^3)	1.086E+004	1.086E+004
Sy-Right (in^3)	1.086E+004	1.086E+004
rx (in)	12.000	12.000
ry (in)	12.000	12.000
Zx (in^3)	1.823E+004	1.823E+004
Zy (in^3)	1.823E+004	1.823E+004
J (in^4)	5.212E+005	5.212E+005



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PROJECT Mn DOT SS-69801 J- P5-3A - Load Distribution along Pier Cap
PROJECT # 090147 DATE 1/19/10 BY jdF [✓] WJM [✓] 5/11/10 SHEET NO. _____ OF _____

Loads to distribute:

Lane = 51.9 kip each lane
divide over 10' width = $51.9 \text{ k} \div 10' = 5.19 \text{ klf}$ ✓
and 2.60 klf at ends.

Truck = 71.3 kip each lane ✓
divide over 2 tires = $71.3 \text{ k} \div 2 = 35.65 \text{ k}$ each.

Distribute these loads as if the slab acts as a simple span between interior beams and the slab cantilevers over the top of the exterior beam. ✓

See Risa Loading Print-outs for Moment & Shear Load Layouts.

Determine Load Combination Factors to use in Risa

Since 1.0 Lane + 1.0 Truck controls, and Impact only applies to the truck portion of the Live Load, ✓ ✓

Use 1.0 Lane + 1.33 Truck + 1.0 CF + 1.0 BR ✓



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PROJECT Mn DOT SS-69801J-P5-3A - One Lane Loading
PROJECT # 090147 DATE 3/17/10 BY jdF SHEET NO. 1 OF 1

jdF
5/11/10

Check if one lane Loading w/ a multiple presence factor, m , of 1.20 controls. See 3.6.1.1.2.

Model the lane and truck loads out the farthest from the supports to both the Left and Right as possible. Compare these shears and moments to the 2-lane shears and moments.

Combine these loads as follows:

$$1.2 \text{ Lane} + \underbrace{1.33 \times 1.2}_{1.596 \checkmark} \text{ Truck} + \underbrace{1.2 \times 0.5}_{0.6 \checkmark} (LF + BR)$$

After Reviewing the Shear and Moment Forces,
One Lane Loading may control.

Review for each check



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PROJECT: MnDOT SS-69801 J - P5-3A - Risa Models
PROJECT # 090147 DATE 2/10/10 BY jdf SHEET NO. _____ OF _____

2 Risa 3D Models of the pier cap have been created.

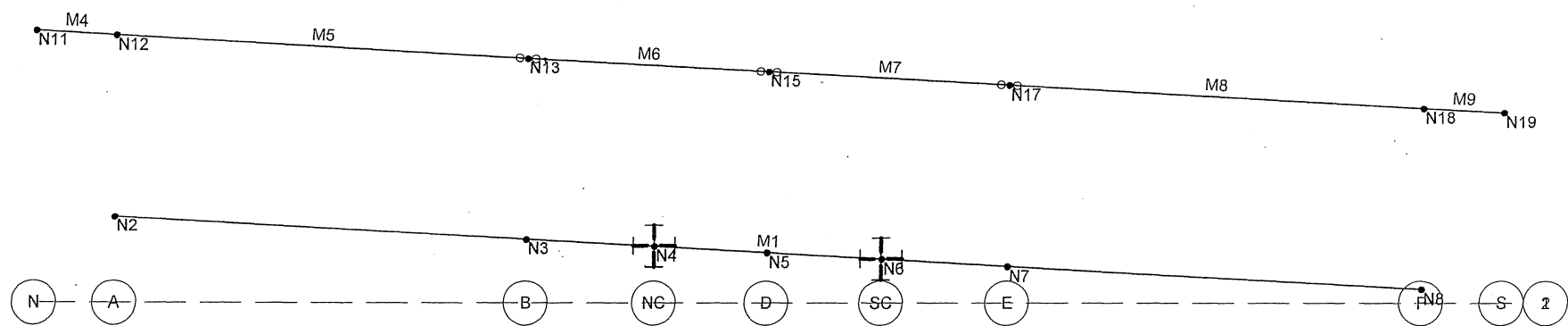
- 1) With a connection between the slab and pier cap at Girder D.
- 2) Without a connection between the slab and pier cap at Girder D.

Girder D frames into the side of the pier cap from the west side only. (It ends at pier 5). Therefore both models were created and the worst case from each will be used.

Model w/ Girder D has the largest shears and is used to check shear.

Model w/o Girder D has the largest moments and is used to check flexure.

8013-3A-P5
Model Input w/D



R-1
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jdf

090147

Bridge 69801 3A Pier 5 With Girder D

Jan 19, 2010 at 3:37 PM

090147_3A_P5_Pier_WGirderD.r3d

5/11/10

Global

Display Sections for Member Calcs	20
Max Internal Sections for Member Calcs	191
Include Shear Deformation	Yes
Include Warping	No
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Vertical Axis	Y

Hot Rolled Steel Code	AISC : LRFD 13th
Cold Formed Steel Code	AISI 01: ASD
Wood Code	NDS 2005: ASD
Wood Temperature	< 100F
Concrete Code	ACI 2005
Masonry Code	MSJC 05/IBC 06 ASD

Number of Shear Regions	4
Region Spacing Increment (in)	4
Biaxial Column Method	Exact Integration
Parme Beta Factor (PCA)	.65
Concrete Stress Block	Rectangular
Use Cracked Sections	Yes
Bad Framing Warnings	No
Unused Force Warnings	Yes

Footing Overturning Safety Factor	1.5
Check Concrete Bearing	Yes
Self Wt, Overburden in DL for Design	Yes
Footing Concrete Weight	.145 k/ft^3
Footing Concrete f'c	3 ksi
Footing Concrete Ec	4000 ksi
Footing Steel fy	60 ksi
Minimum Steel	0.0018
Maximum Steel	0.0075
Footing Top Bar	#3
Footing Top Bar Cover	3.5 in
Footing Bottom Bar	#4
Footing Bottom Bar Cover	3.5 in
Pedestal Bar	#3
Pedestal Bar Cover	1.5 in
Pedestal Ties	#3

General Material Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (1/E5 F)	Density[k/ft^3]
1	A36 Steel	29000	11154	.3	.65	.49

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (1/E5 F)	Density[k/ft^3]	Yield[ksi]
1	A36	29000	11154	.3	.65	.49	36

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rules	A [in^2]	Iyy [in^4]	Izz [in^4]	J [in^4]
1	Slab	W8X40	Beam	None	A36	Typical	11.7	49.1	146	1.12

Company : LHB
 Designer : jdf
 Job Number : 090147

Bridge 69801 3A Pier 5 With Girder D

Apr 19, 2010
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Member Primary Data

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1	N2	N8			BR3A-5a	Beam	None	A36 Steel	Default
2	M4	N11	N12			Slab	Beam	None	A36	Typical
3	M5	N12	N13			Slab	Beam	None	A36	Typical
4	M6	N13	N15			Slab	Beam	None	A36	Typical
5	M7	N15	N17			Slab	Beam	None	A36	Typical
6	M8	N17	N18			Slab	Beam	None	A36	Typical
7	M9	N18	N19			Slab	Beam	None	A36	Typical

Member Advanced Data

	Label	I Release	J Release	I Offset[in]	J Offset[in]	T/C Only	Physical	TOM	Inactive
1	M1						Yes	Yes	
2	M4						Yes	Yes	
3	M5		BenPIN				Yes	Yes	
4	M6	BenPIN	BenPIN				Yes	Yes	
5	M7	BenPIN	BenPIN				Yes	Yes	
6	M8	BenPIN					Yes	Yes	
7	M9						Yes	Yes	

Joint Coordinates and Temperatures

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
1	N2	1.75	1.902	0	0	
2	N3	10.75	1.398	0	0	
3	N4	13.57	1.24	0	0	
4	N5	16.05	1.1	0	0	
5	N6	18.57	.96	0	0	
6	N7	21.34	.805	0	0	
7	N8	30.39	.298	0	0	
8	N11	0	6	0	0	
9	N12	1.75	5.902	0	0	
10	N13	10.75	5.398	0	0	
11	N15	16.05	5.1	0	0	
12	N17	21.34	4.805	0	0	
13	N18	30.39	4.298	0	0	
14	N19	32.14	4.2	0	0	

Joint Boundary Conditions

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot.[k-ft/rad]	Y Rot.[k-ft/rad]	Z Rot.[k-ft/rad]	Footing
1	N4	Reaction	Reaction	Reaction	Reaction			
2	N6	Reaction	Reaction	Reaction	Reaction			
3	N12	SlaveN2	SlaveN2	SlaveN2	SlaveN2			
4	N13	SlaveN3	SlaveN3	SlaveN3	SlaveN3			
5	N17	SlaveN7	SlaveN7	SlaveN7	SlaveN7			
6	N18	SlaveN8	SlaveN8	SlaveN8	SlaveN8			
7	N15	SlaveN5	SlaveN5	SlaveN5	SlaveN5			

Joint Loads and Enforced Displacements (BLC 7 : Centrifigual Force)

	Joint Label	L,D,M	Direction	Magnitude[(k.k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Y	-9.25
2	N3	L	Y	-3.43
3	N2	L	X	-6.1
4	N3	L	X	-6.1

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Joint Loads and Enforced Displacements (BLC 7 : Centrifigal Force) (Continued)

	Joint Label	L,D,M	Direction	Magnitude[(k.k-ft), (in.rad), (k*s^2/ft...]
5	N5	L	X	-6.1
6	N7	L	X	-6.1
7	N8	L	X	-6.1

Joint Loads and Enforced Displacements (BLC 8 : Noncomp Dead)

	Joint Label	L,D,M	Direction	Magnitude[(k.k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Y	-80.33
2	N3	L	Y	-97.05
3	N5	L	Y	10.74
4	N7	L	Y	-93.64
5	N8	L	Y	-71.74

Joint Loads and Enforced Displacements (BLC 9 : Superimposed Dead)

	Joint Label	L,D,M	Direction	Magnitude[(k.k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Y	-22.19
2	N3	L	Y	-26.5
3	N5	L	Y	.16
4	N7	L	Y	-26.09
5	N8	L	Y	-20.58

Joint Loads and Enforced Displacements (BLC 10 : MDX Bracing Weight)

	Joint Label	L,D,M	Direction	Magnitude[(k.k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Y	1.48
2	N3	L	Y	2.76
3	N5	L	Y	2.57
4	N7	L	Y	2.75
5	N8	L	Y	1.47

Member Point Loads (BLC 2 : Lanes Seperate)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M4	Y	-2.6	0
2	M4	Y	-5.19	1
3	M5	Y	-5.19	.25
4	M5	Y	-5.19	1.25
5	M5	Y	-5.19	2.25
6	M5	Y	-5.19	3.25
7	M5	Y	-5.19	4.25
8	M5	Y	-5.19	5.25
9	M5	Y	-5.19	6.25
10	M5	Y	-5.19	7.25
11	M5	Y	-2.6	8.25
12	M8	Y	-2.6	.8
13	M8	Y	-5.19	1.8
14	M8	Y	-5.19	2.8
15	M8	Y	-5.19	3.8
16	M8	Y	-5.19	4.8
17	M8	Y	-5.19	5.8
18	M8	Y	-5.19	6.8
19	M8	Y	-5.19	7.8
20	M8	Y	-5.19	8.8
21	M9	Y	-5.19	.75
22	M9	Y	-2.6	1.75

Member Point Loads (BLC 3 : Lanes Together R)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
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5/11/10

Member Point Loads (BLC 3 : Lanes Together R) (Continued)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M5	Y	-2.6	8.39
2	M6	Y	-5.19	.39
3	M6	Y	-5.19	1.39
4	M6	Y	-5.19	2.39
5	M6	Y	-5.19	3.39
6	M6	Y	-5.19	4.39
7	M7	Y	-5.19	.09
8	M7	Y	-5.19	1.09
9	M7	Y	-5.19	2.09
10	M7	Y	-5.19	3.09
11	M7	Y	-2.6	4.09
12	M8	Y	-2.6	.8
13	M8	Y	-5.19	1.8
14	M8	Y	-5.19	2.8
15	M8	Y	-5.19	3.8
16	M8	Y	-5.19	4.8
17	M8	Y	-5.19	5.8
18	M8	Y	-5.19	6.8
19	M8	Y	-5.19	7.8
20	M8	Y	-5.19	8.8
21	M9	Y	-5.19	.75
22	M9	Y	-2.6	1.75

Member Point Loads (BLC 4 : Trucks Seperate)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M5	Y	-35.65	.25
2	M5	Y	-35.65	6.25
3	M8	Y	-35.65	2.8
4	M8	Y	-35.65	8.8

Member Point Loads (BLC 5 : Trucks Together R)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M6	Y	-35.65	3.39
2	M7	Y	-35.65	4.09
3	M8	Y	-35.65	2.8
4	M8	Y	-35.65	8.8

Member Point Loads (BLC 6 : Trucks Together L)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M5	Y	-35.65	.25
2	M5	Y	-35.65	6.25
3	M6	Y	-35.65	1.25
4	M7	Y	-35.65	1.95

Member Point Loads (BLC 11 : Lanes Together L)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M4	Y	-2.6	0
2	M4	Y	-5.19	1
3	M5	Y	-5.19	.25
4	M5	Y	-5.19	1.25
5	M5	Y	-5.19	2.25
6	M5	Y	-5.19	3.25
7	M5	Y	-5.19	4.25
8	M5	Y	-5.19	5.25
9	M5	Y	-5.19	6.25
10	M5	Y	-5.19	7.25

R-5

Member Point Loads (BLC 11 : Lanes Together L) (Continued)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
11	M5	Y	-2.6	8.25
12	M6	Y	-2.6	1.75
13	M6	Y	-5.19	2.75
14	M6	Y	-5.19	3.75
15	M6	Y	-5.19	4.75
16	M7	Y	-5.19	.45
17	M7	Y	-5.19	1.45
18	M7	Y	-5.19	2.45
19	M7	Y	-5.19	3.45
20	M7	Y	-5.19	4.45
21	M8	Y	-5.19	.16
22	M8	Y	-2.6	1.16

Member Point Loads (BLC 13 : 1 Lane R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M8	Y	-2.6	.8
2	M8	Y	-5.19	1.8
3	M8	Y	-5.19	2.8
4	M8	Y	-5.19	3.8
5	M8	Y	-5.19	4.8
6	M8	Y	-5.19	5.8
7	M8	Y	-5.19	6.8
8	M8	Y	-5.19	7.8
9	M8	Y	-5.19	8.8
10	M9	Y	-5.19	.75
11	M9	Y	-2.6	1.75

Member Point Loads (BLC 14 : 1 Lane L)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M4	Y	-2.6	0
2	M4	Y	-5.19	1
3	M5	Y	-5.19	.25
4	M5	Y	-5.19	1.25
5	M5	Y	-5.19	2.25
6	M5	Y	-5.19	3.25
7	M5	Y	-5.19	4.25
8	M5	Y	-5.19	5.25
9	M5	Y	-5.19	6.25
10	M5	Y	-5.19	7.25
11	M5	Y	-2.6	8.25

Member Point Loads (BLC 15 : 1 Truck R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M8	Y	-35.65	2.8
2	M8	Y	-35.65	8.8

Member Point Loads (BLC 16 : 1 Truck L)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M5	Y	-35.65	.25
2	M5	Y	-35.65	6.25

Member Distributed Loads (BLC 1 : Pier Cap Weight)

	Member Label	Direction	Start Magnitude[k/ft,d...]	End Magnitude[k/ft,d...]	Start Location[ft, %]	End Location[ft, %]
1	M1	Y	-.355	-.489	0	10.3

Company : LHB
 Designer : jdf
 Job Number : 090147

Bridge 69801 3A Pier 5 With Girder D

Apr 19, 2010
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 Checked By: CJM

5/11/10

Member Distributed Loads (BLC 1 : Pier Cap Weight) (Continued)

	Member Label	Direction	Start Magnitude[k/ft.d...]	End Magnitude[k/ft.d...]	Start Location[ft.%]	End Location[ft.%]
2	M1	Y	-.598	-.576	10.3	18.4
3	M1	Y	-.467	-.355	18.4	100

Member Distributed Loads (BLC 12 : Braking Force)

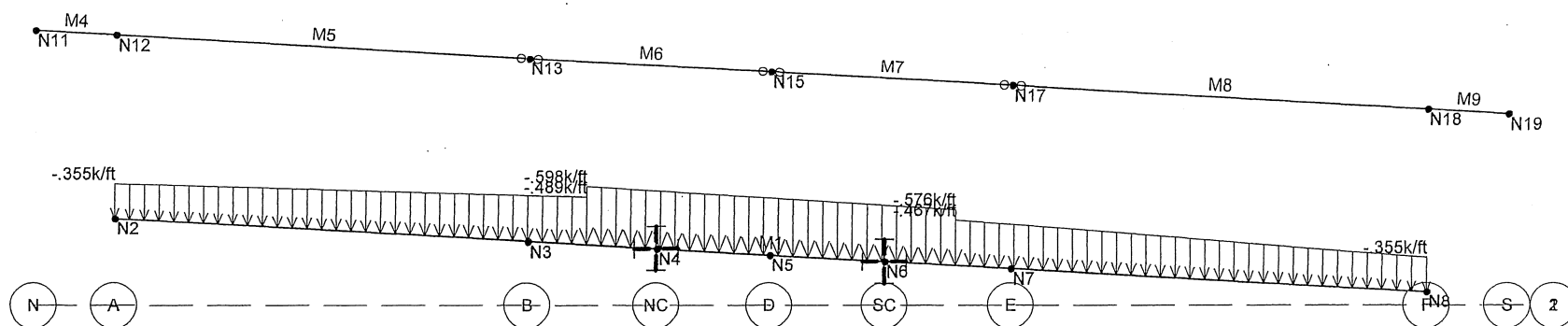
	Member Label	Direction	Start Magnitude[k/ft.d...]	End Magnitude[k/ft.d...]	Start Location[ft.%]	End Location[ft.%]
1	M4	Z	.731	.731	0	0
2	M5	Z	.731	.731	0	0
3	M6	Z	.731	.731	0	0
4	M7	Z	.731	.731	0	0
5	M8	Z	.731	.731	0	0
6	M9	Z	.731	.731	0	0

Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distributed Area (Me... Surface (...)
1	Pier Cap Weight	DL						3
2	Lanes Seperate	LL					22	
3	Lanes Together R	LL					22	
4	Trucks Seperate	LL					4	
5	Trucks Together R	LL					4	
6	Trucks Together L	LL					4	
7	Centrifigual Force	LL				7		
8	Noncomp Dead	DL				5		
9	Superimposed Dead	DL				5		
10	MDX Bracing Weight	DL				5		
11	Lanes Together L	LL					22	
12	Braking Force	LL						6
13	1 Lane R	LL					11	
14	1 Lane L	LL					11	
15	1 Truck R	LL					2	
16	1 Truck L	LL					2	

Load Combinations

	Description	Sol...	PD...	SR...	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor
1	Loads Seperate				2	1	4	1.33	7	1	12	1					
2	Loads Together L				11	1	6	1.33	7	1	12	1					
3	Loads Together R				3	1	5	1.33	7	1	12	1					
4	All Dead Loads				DL	1											
5	One Lane R	Yes			13	1.2	15	1.596	7	.6	12	.6					
6	One Lane L	Yes			14	1.2	16	1.596	7	.6	12	.6					



ACM
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Loads: BLC 1, Pier Cap Weight

LHB

jdf

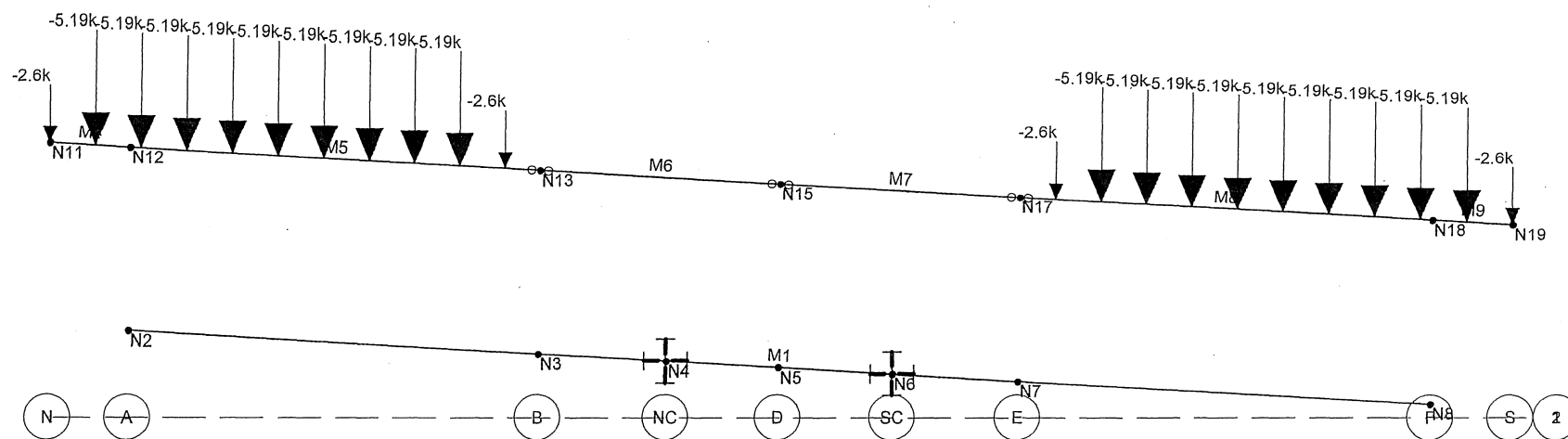
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Bridge 69801 3A Pier 5 With Girder D

Jan 19, 2010 at 3:11 PM

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R-8



1/15/10
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Loads: BLC 2, Lanes Seperate

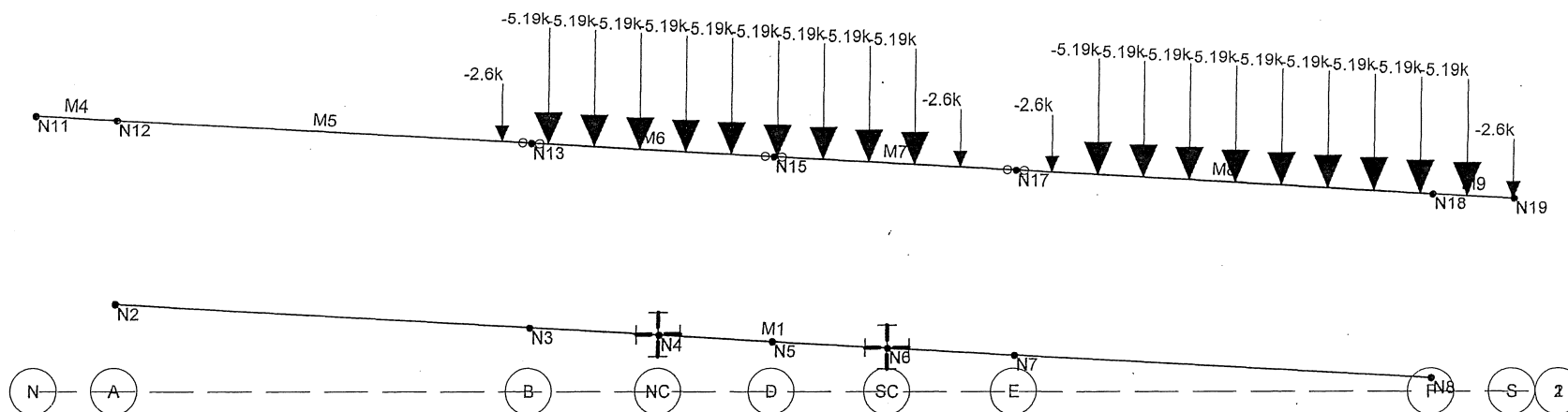
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Bridge 69801 3A Pier 5 With Girder D

Jan 19, 2010 at 3:11 PM

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R-9



VCSm
5/11/10

Loads: BLC 3, Lanes Together R

LHB

jdf

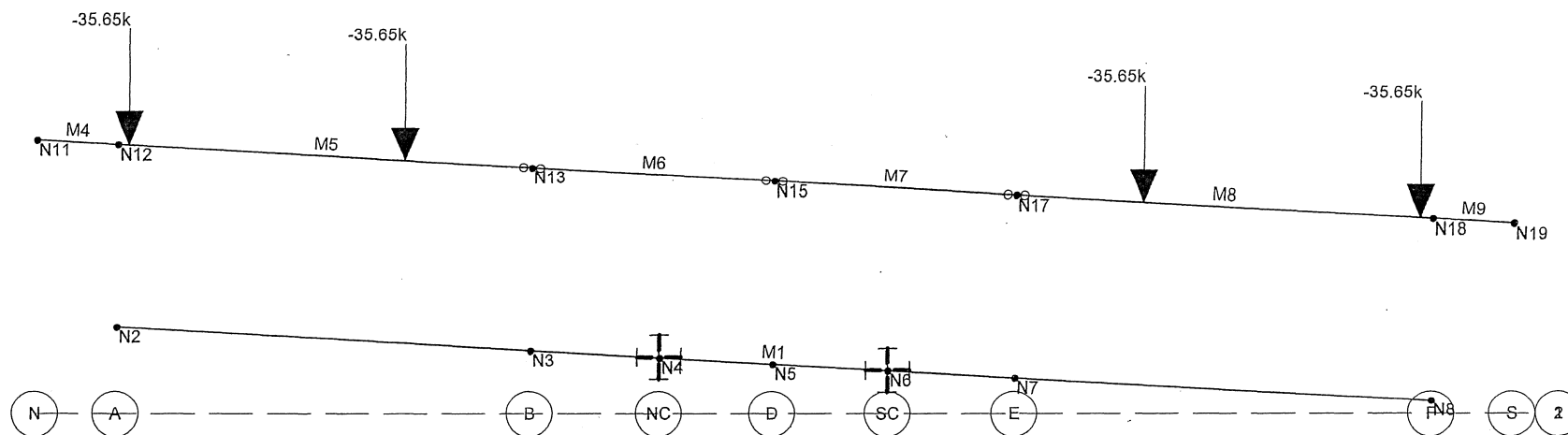
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Bridge 69801 3A Pier 5 With Girder D

Jan 19, 2010 at 3:11 PM

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R-10



65m
5/11/10

Loads: BLC 4, Trucks Seperate

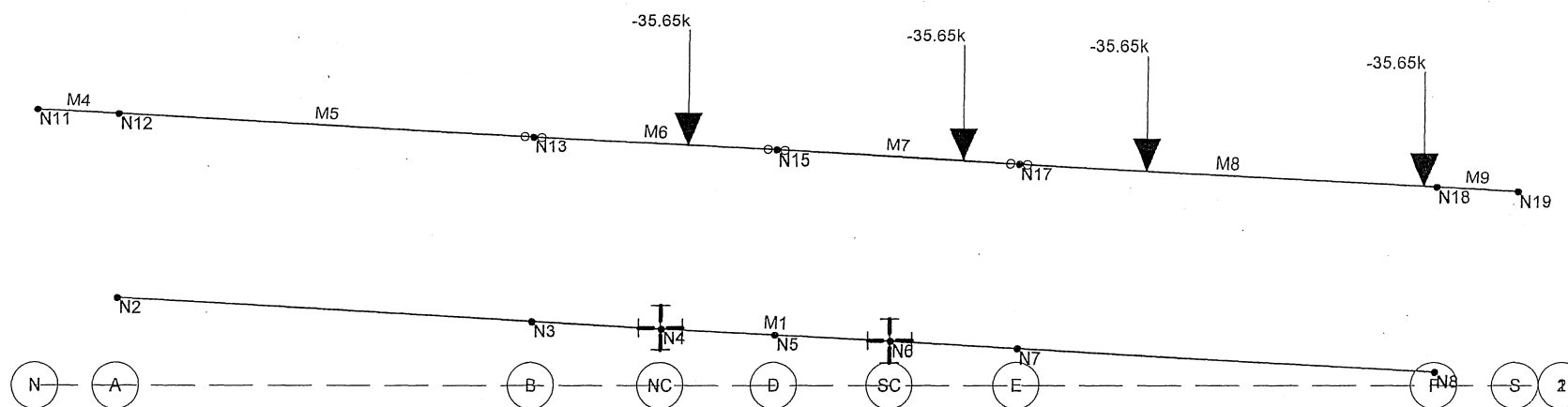
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Bridge 69801 3A Pier 5 With Girder D

Jan 19, 2010 at 3:11 PM

090147_3A_P5_Pier_WGirderD.r3d

R-11



from
studio

Loads: BLC 5, Trucks Together R

LHB

jdf

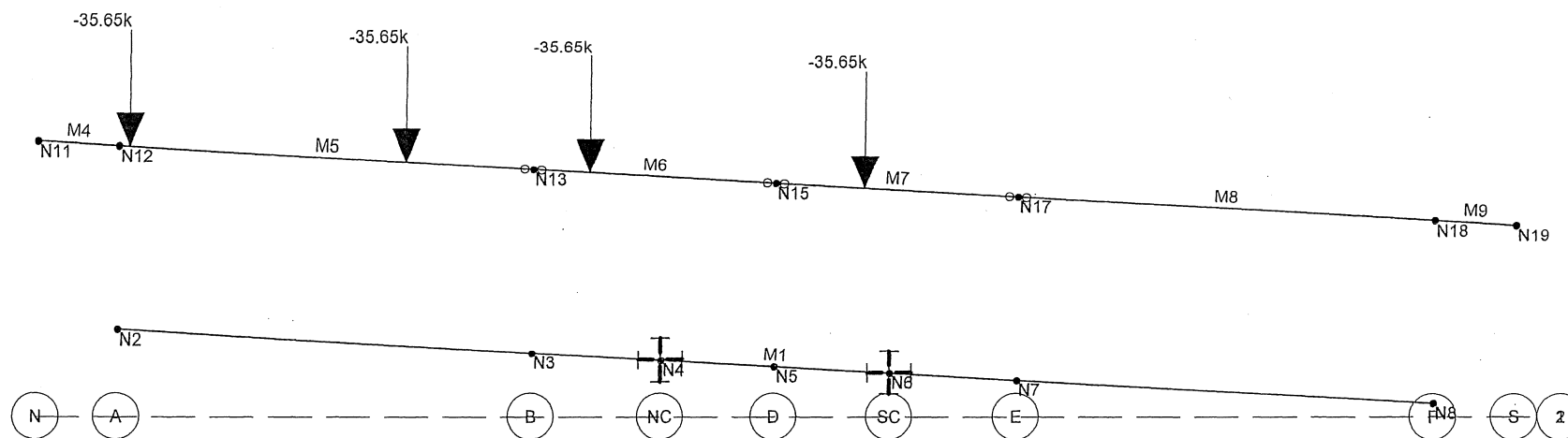
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Bridge 69801 3A Pier 5 With Girder D

Jan 19, 2010 at 3:12 PM

090147_3A_P5_Pier_WGirderD.r3d

R-12



Loads: BLC 6, Trucks Together L

LHB

jdf

090147

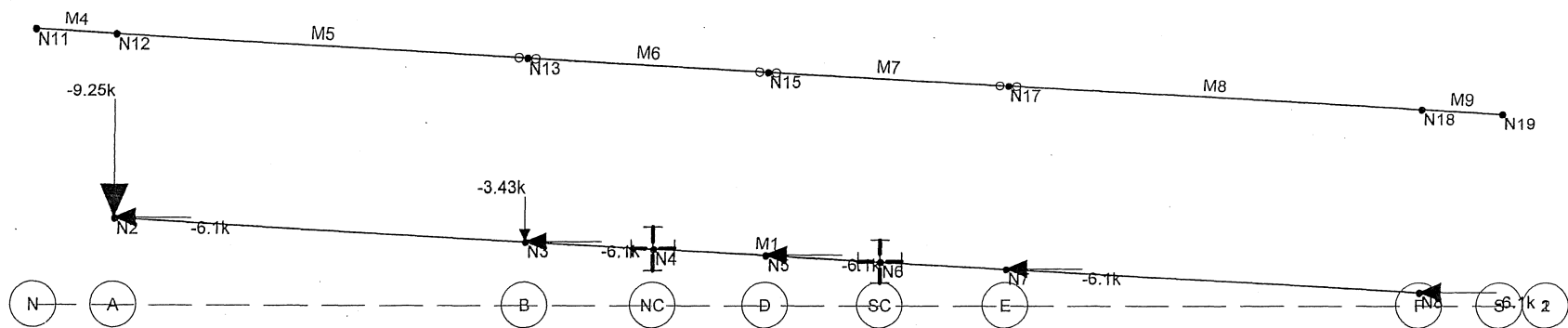
Bridge 69801 3A Pier 5 With Girder D

Jan 19, 2010 at 3:12 PM

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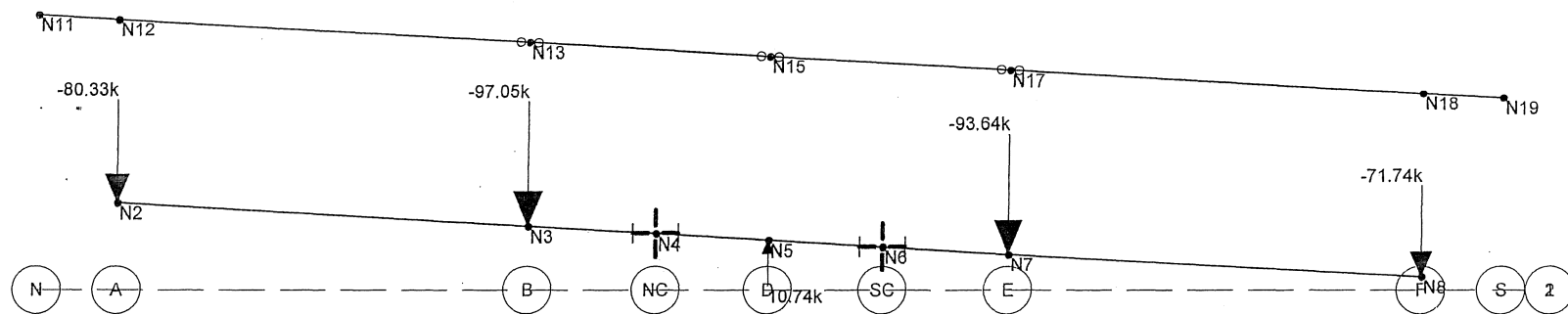
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slm

R-13



090147_3A_P5_Pier_WGirderD.r3d

✓ 5/11/0



1/5m
5/11/10

Loads: BLC 8, Noncomp Dead

LHB

jdf

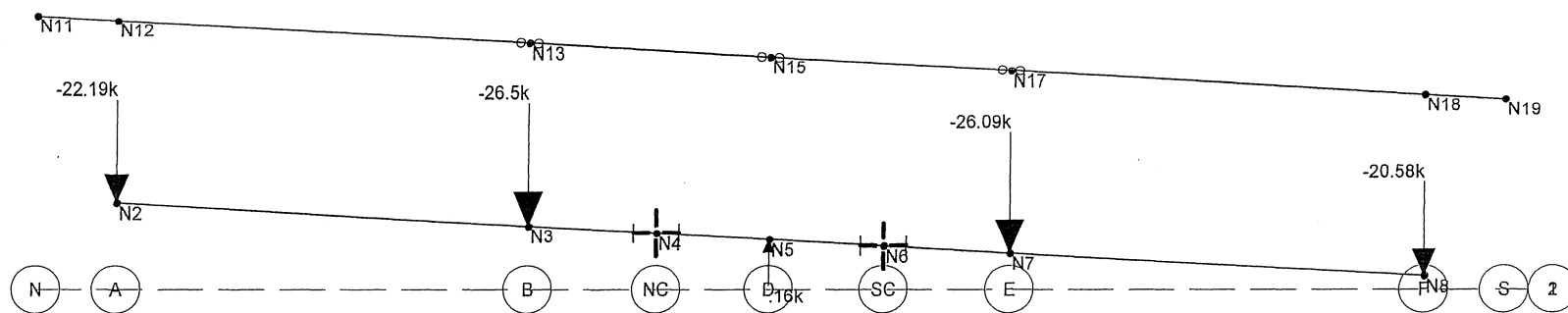
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Bridge 69801 3A Pier 5 With Girder D

Feb 3, 2010 at 9:46 AM

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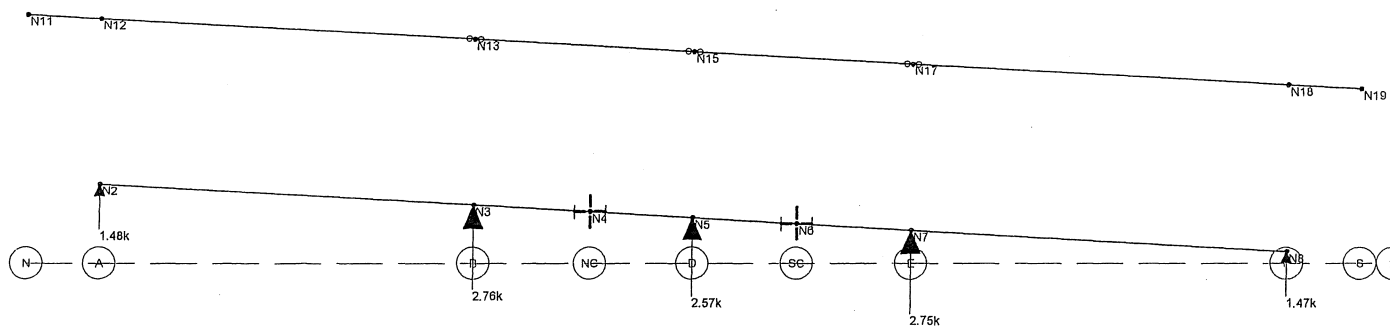
R-15



090147_3A_P5_Pier_WGirderD.r3d

5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100

Y
Z
x

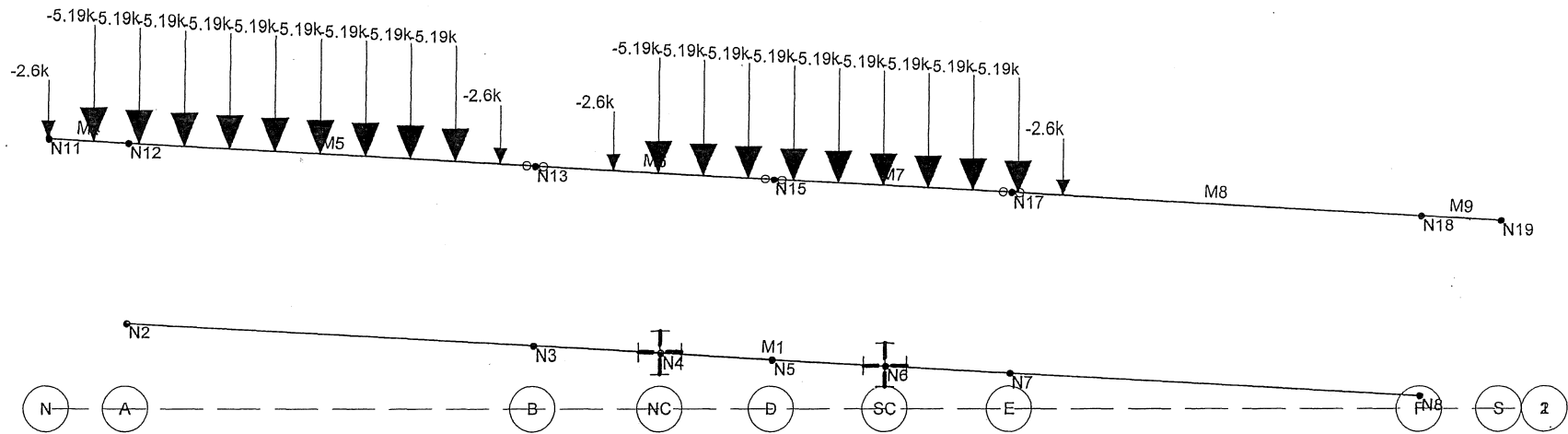


1.53m
57m

Loads: BLC 10, MDX Bracing Weight

LHB	Bridge 69801 3A Pier 5 With Girder D	
jdf		Feb 25, 2010 at 2:26 PM
090147		090147_3A_P5_Pier_WGirderD.r3d

R-17



Loads: BLC 11, Lanes Together L

LHB
jdf
090147

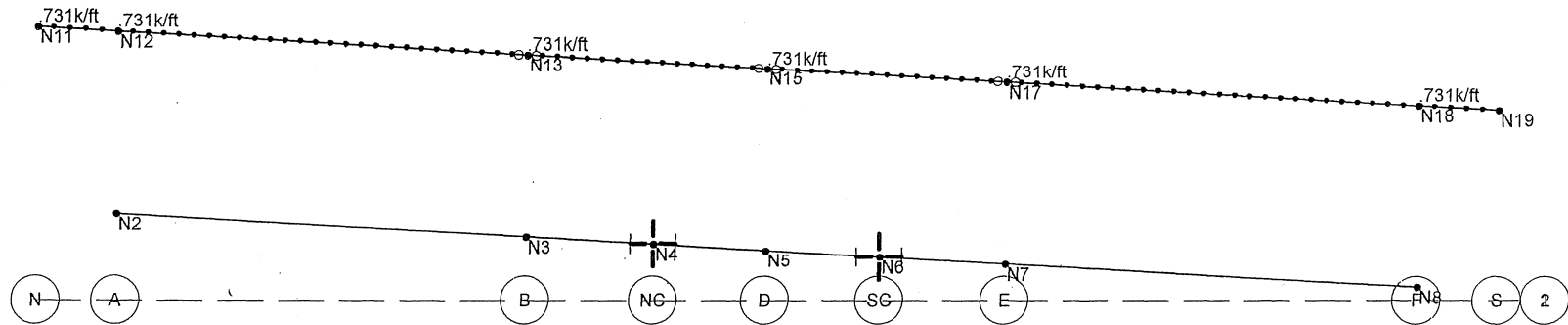
Bridge 69801 3A Pier 5 With Girder D

Jan 19, 2010 at 3:12 PM

090147_3A_P5_Pier_WGirderD.r3d

15m
5.19k
w25

R-18



Loads: BLC 12, Braking Force

LHB

jdf

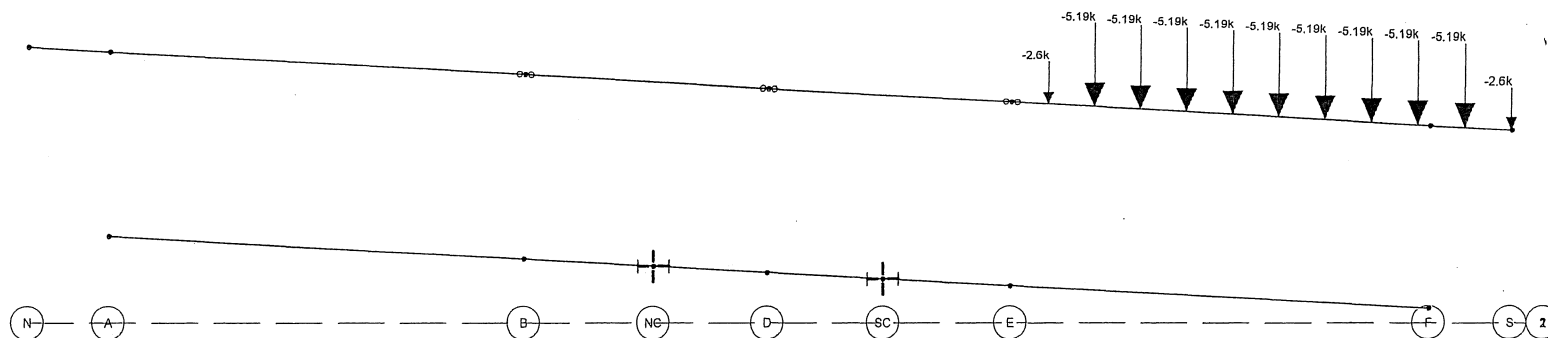
090147

Bridge 69801 3A Pier 5 With Girder D

Feb 3, 2010 at 9:46 AM

090147_3A_P5_Pier_WGirderD.r3d

10/2/10
S. J. J.



Loads: BLC 13, 1 Lane R

LHB

jdf

090147

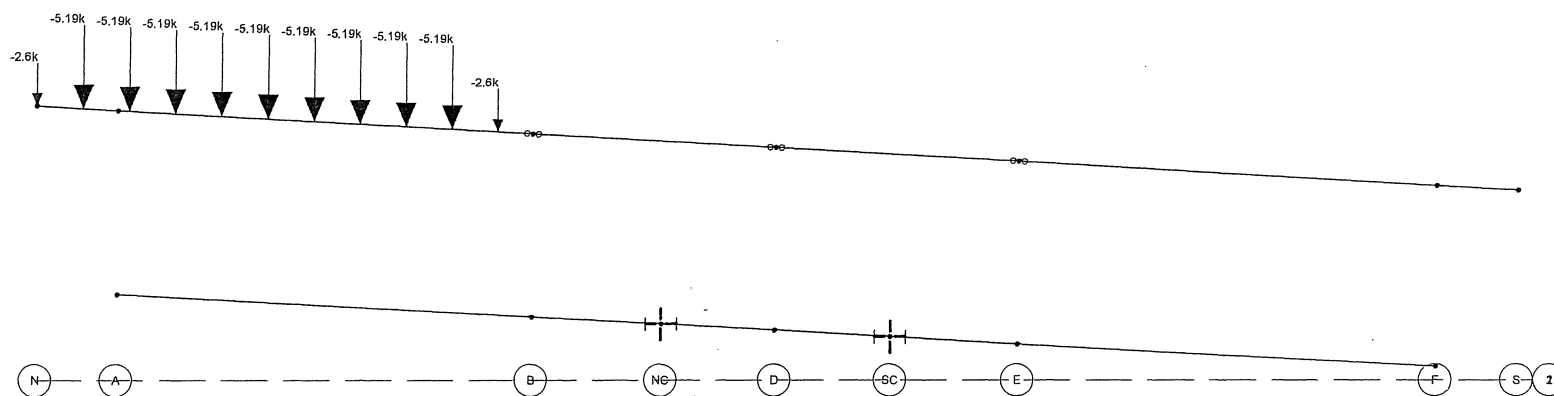
Bridge 69801 3A Pier 5 With Girder D

Apr 19, 2010 at 2:11 PM

090147_3A_P5_Pier_WGirderD.r3d

163m
5/1/10

R-770



Loads: BLC 14, 1 Lane L

LHB

jdf

090147

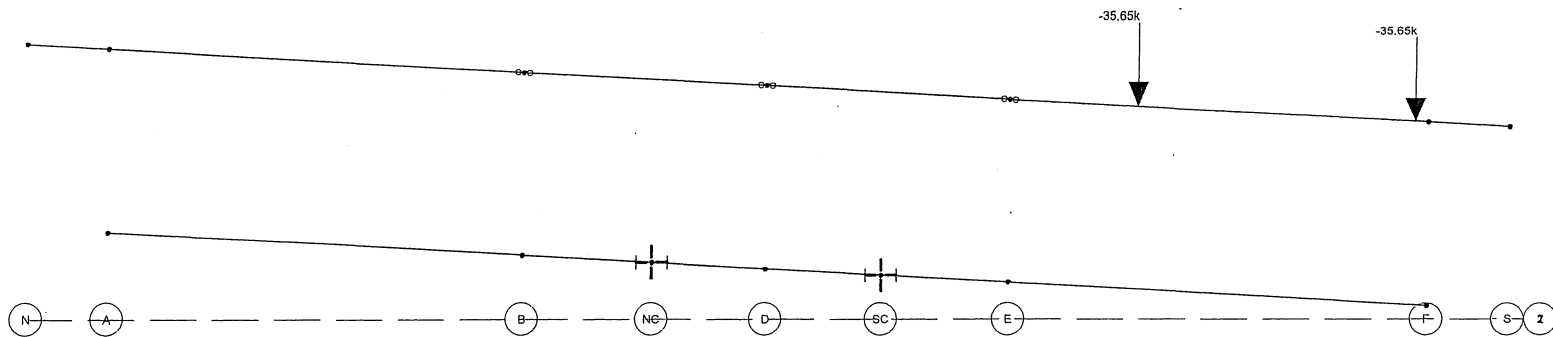
Bridge 69801 3A Pier 5 With Girder D

Apr 19, 2010 at 2:11 PM

090147_3A_P5_Pier_WGirderD.r3d

105m
571m

R-21



LCM
SLIP

Loads: BLC 15, 1 Truck R

LHB

jdf

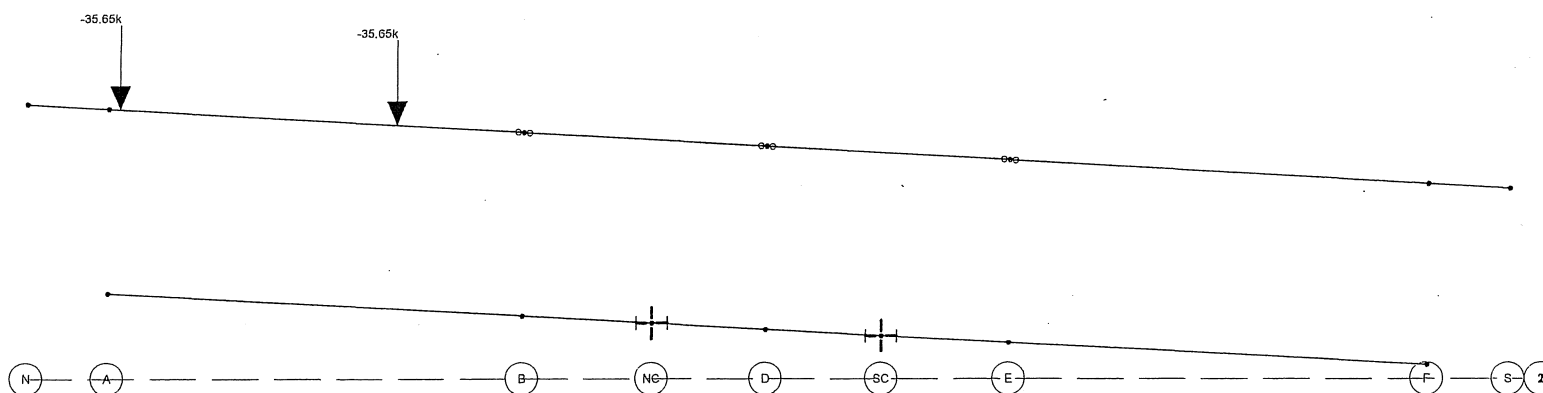
090147

Bridge 69801 3A Pier 5 With Girder D

Apr 19, 2010 at 2:11 PM

090147_3A_P5_Pier_WGirderD.r3d

R-22



U.S.M.
5/11/10

Loads: BLC 16, 1 Truck L

LHB

jdf

090147

Bridge 69801 3A Pier 5 With Girder D

Apr 19, 2010 at 2:11 PM

090147_3A_P5_Pier_WGirderD.r3d

R-23

690012-3A-P3
Model Results w/0

✓com
5/11/10

Beam: **M1**

Shape: **BR3A-5a**

Material: **A36 Steel**

Length: **28.685 ft**

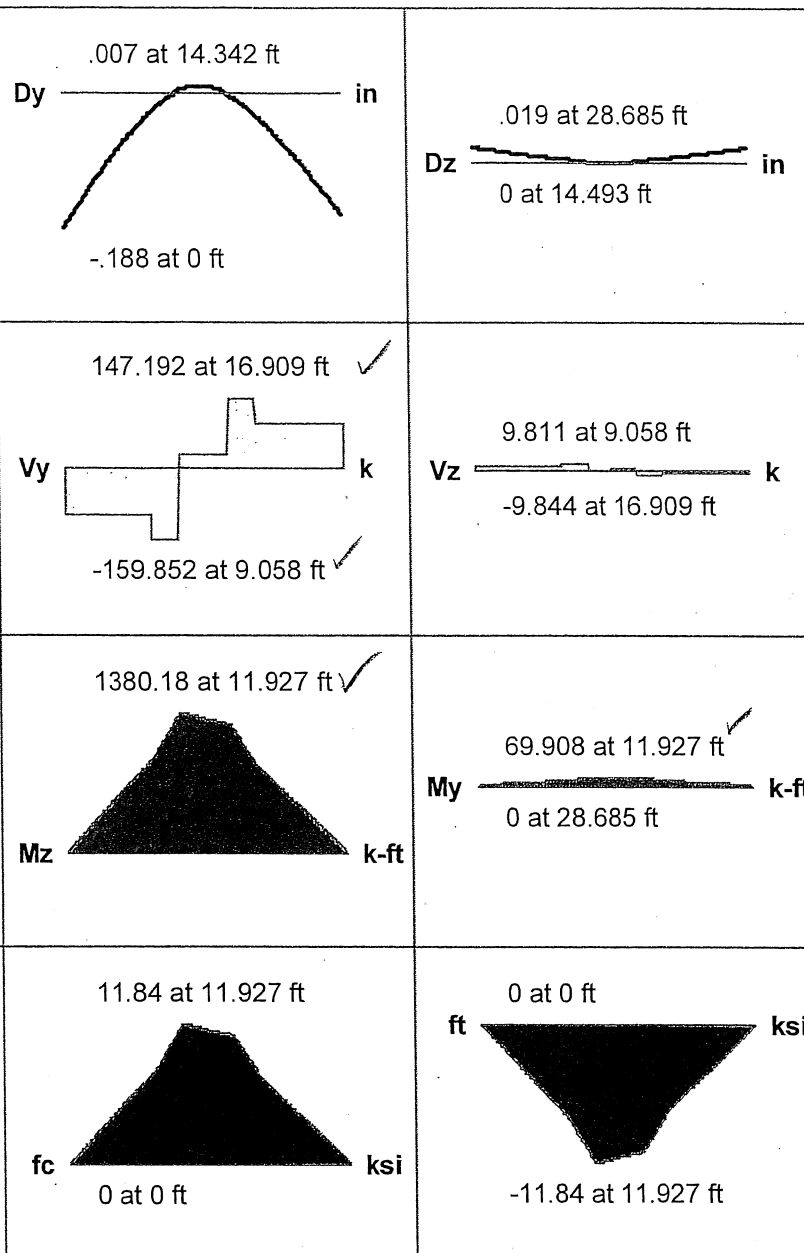
I Joint: **N2**

J Joint: **N8**

LC 1: Loads Seperate

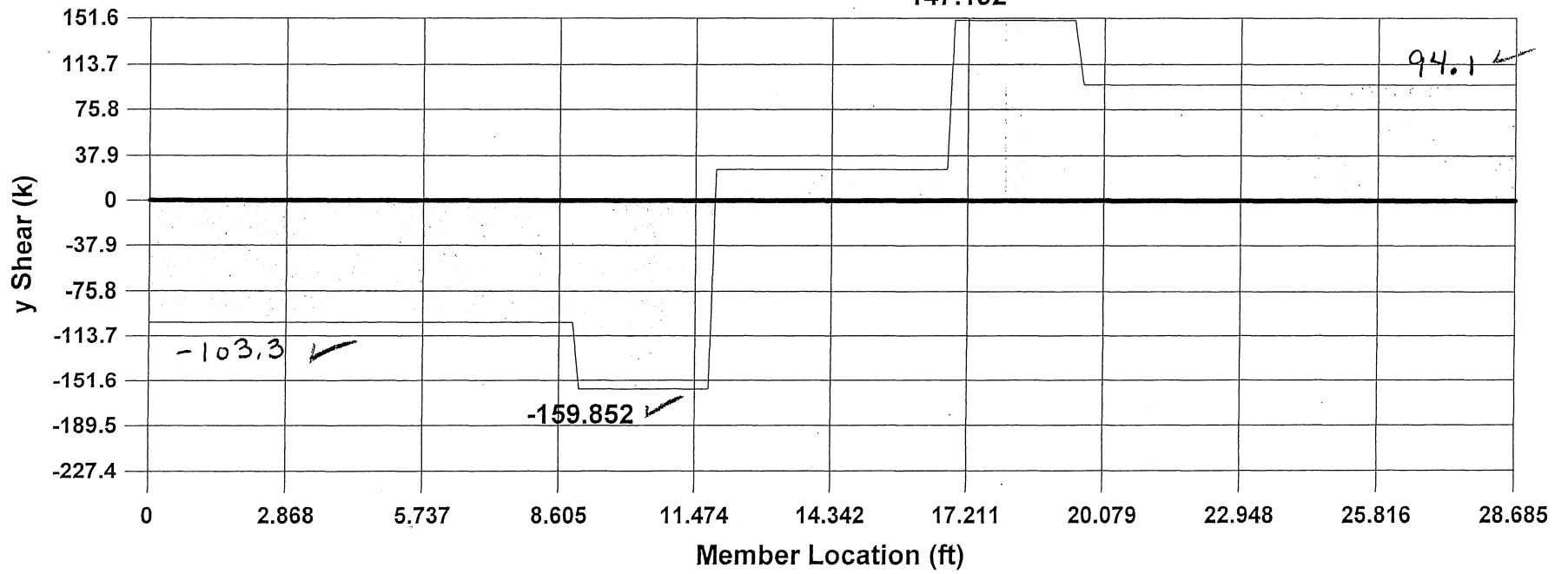
Code Check: **0.000 (bending)**

Report Based On 191 Sections



Member M1 , LC 1: Loads Seperate

147.192 ✓



S-2

105m
5/11/10
0111-2

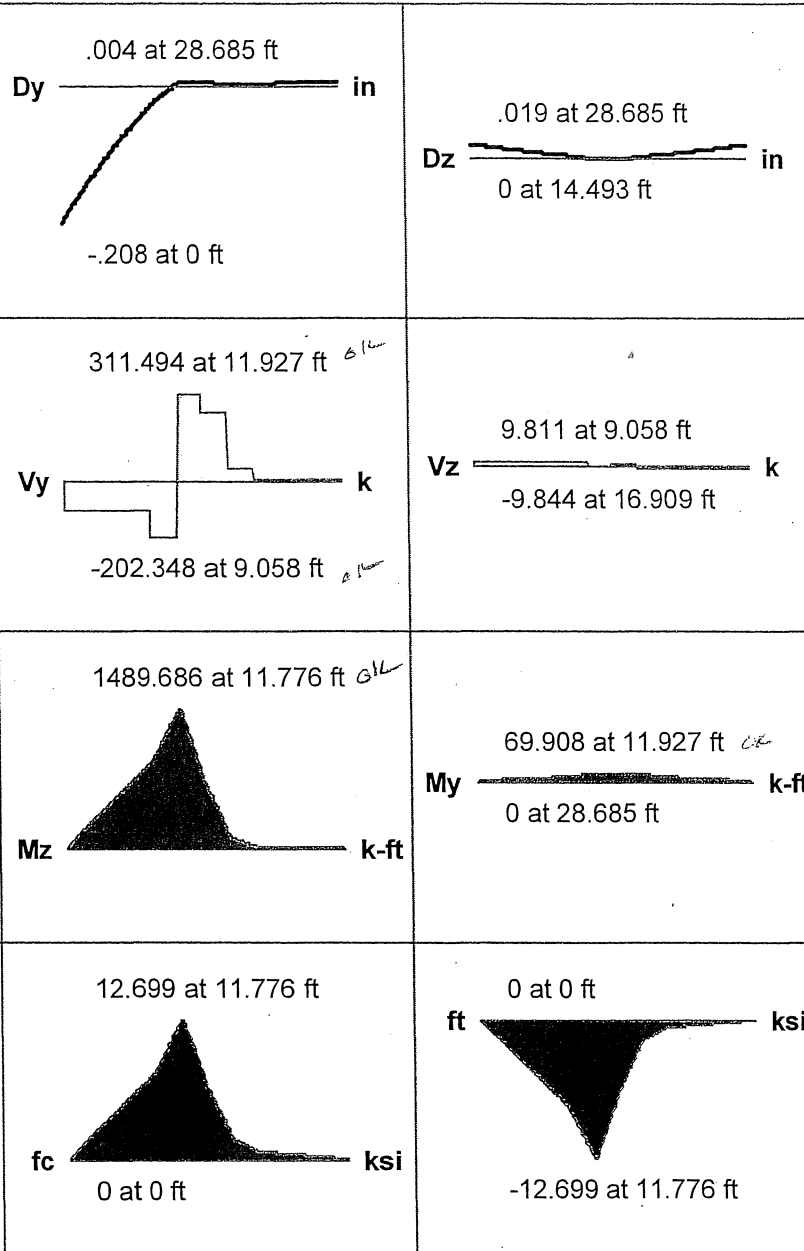
VCSM
5/11/10

Beam: **M1**

Shape: **BR3A-5a**
Material: **A36 Steel**
Length: **28.685 ft**
I Joint: **N2**
J Joint: **N8**

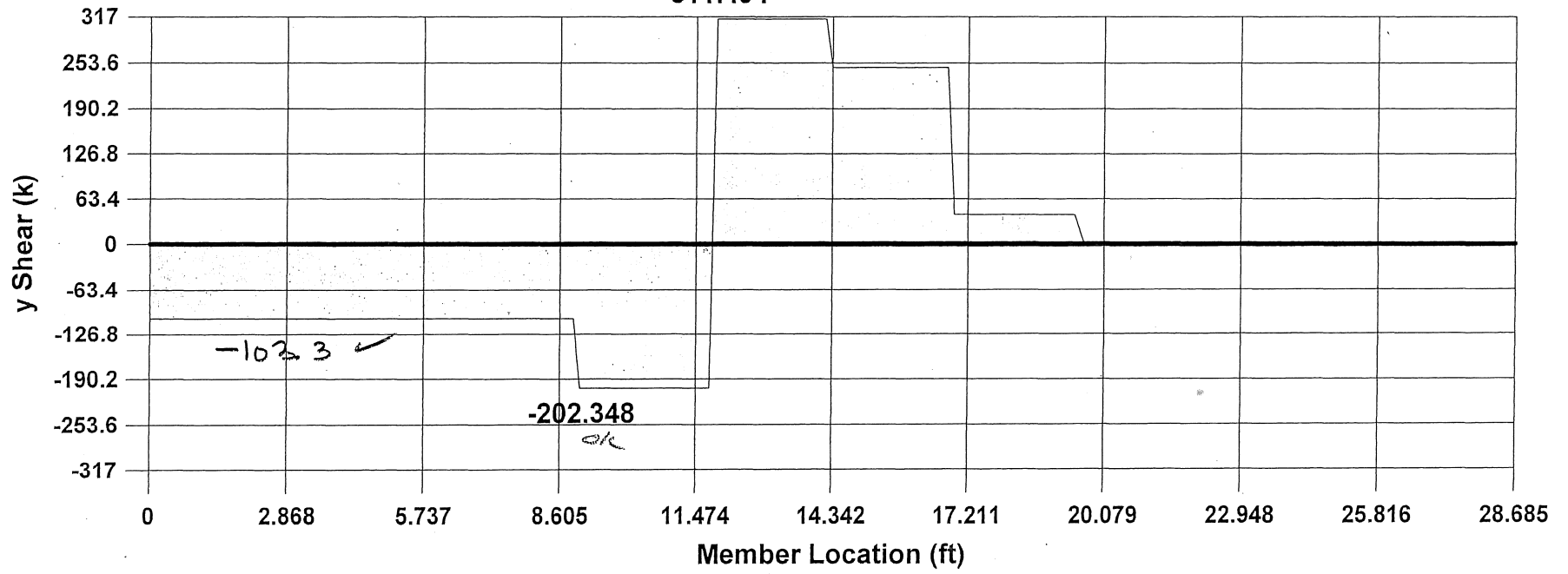
LC 2: Loads Together L

Code Check: **0.000 (bending)**
Report Based On 191 Sections



Member M1 , LC 2: Loads Together L

311.494 *ok*



S-4

1/5/11
5/11/11

✓CSM
5/11/10

Beam: **M1**

Shape: **BR3A-5a**

Material: **A36 Steel**

Length: **28.685 ft**

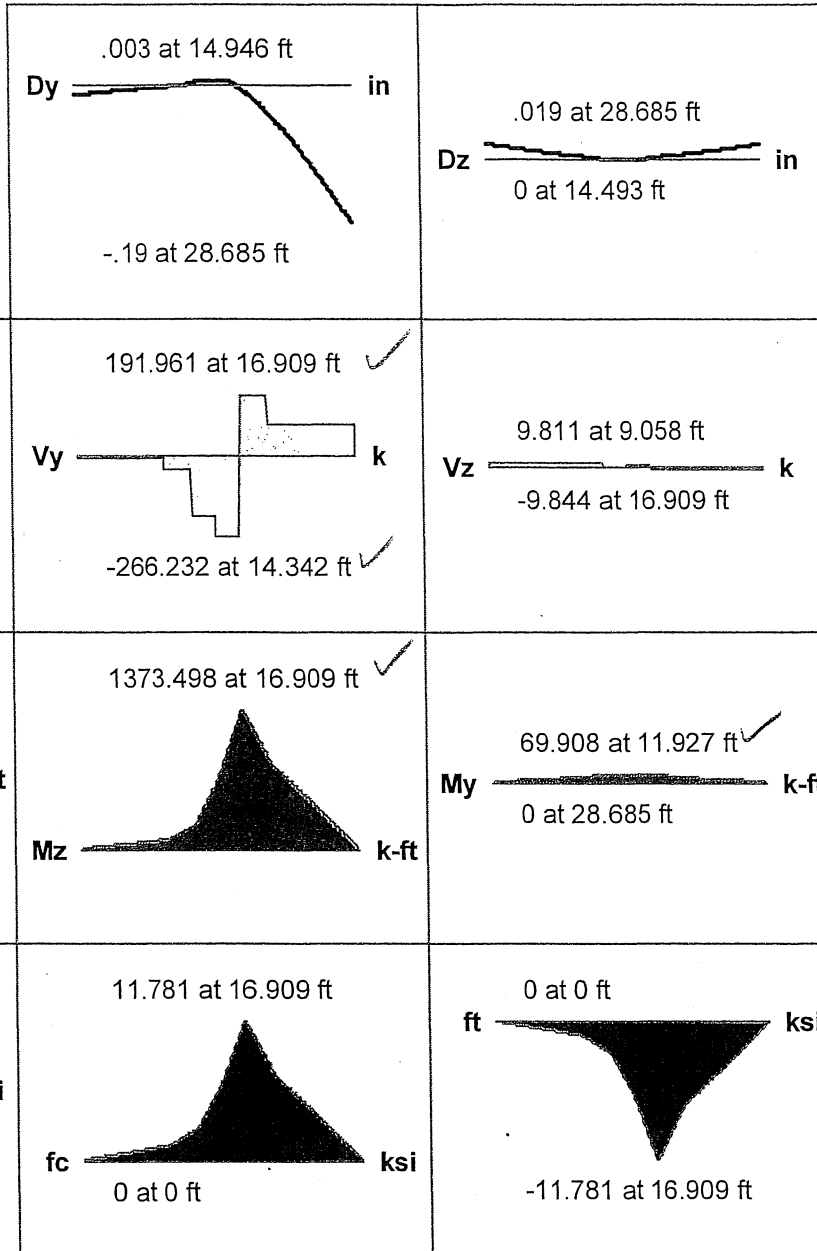
I Joint: **N2**

J Joint: **N8**

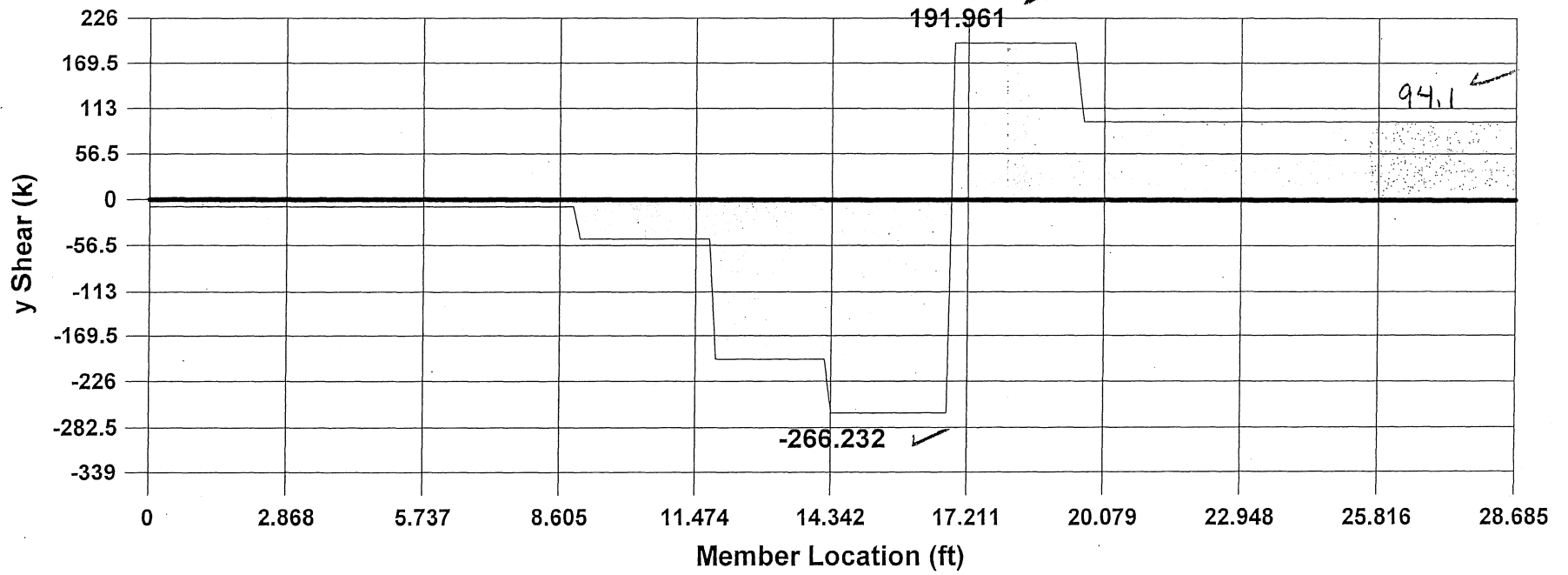
LC 3: Loads Together R

Code Check: **0.000 (bending)**

Report Based On 191 Sections



Member M1 , LC 3: Loads Together R



✓
65M
5/11/10

9-8

VCSM
5/11/10

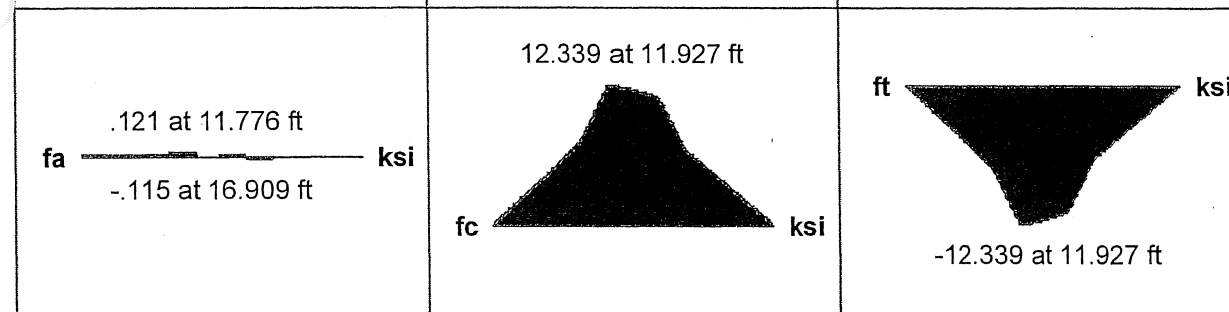
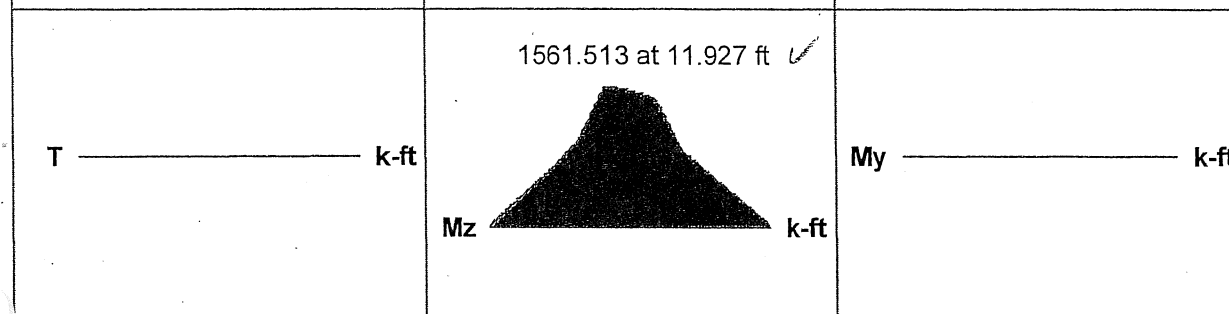
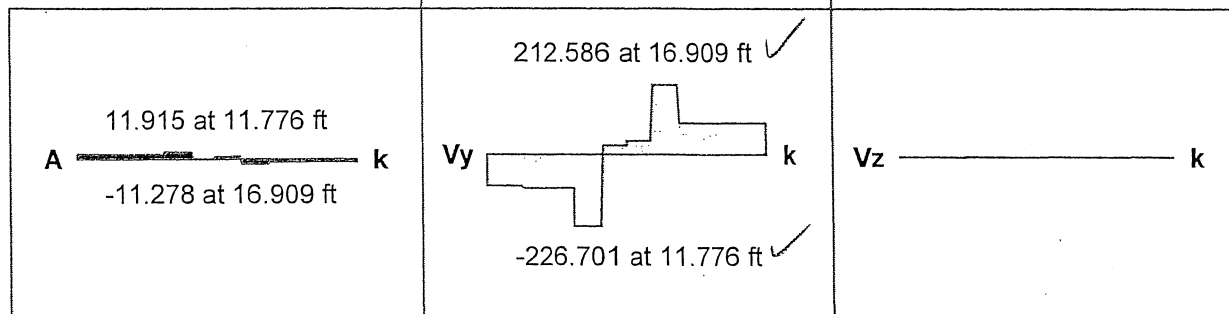
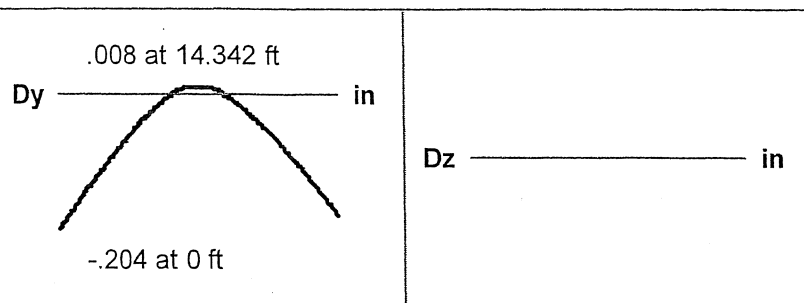
Beam: **M1**

Shape: **BR3A-5a**
Material: **A36 Steel**
Length: **28.685 ft**
I Joint: **N2**
J Joint: **N8**

LC 4: All Dead Loads

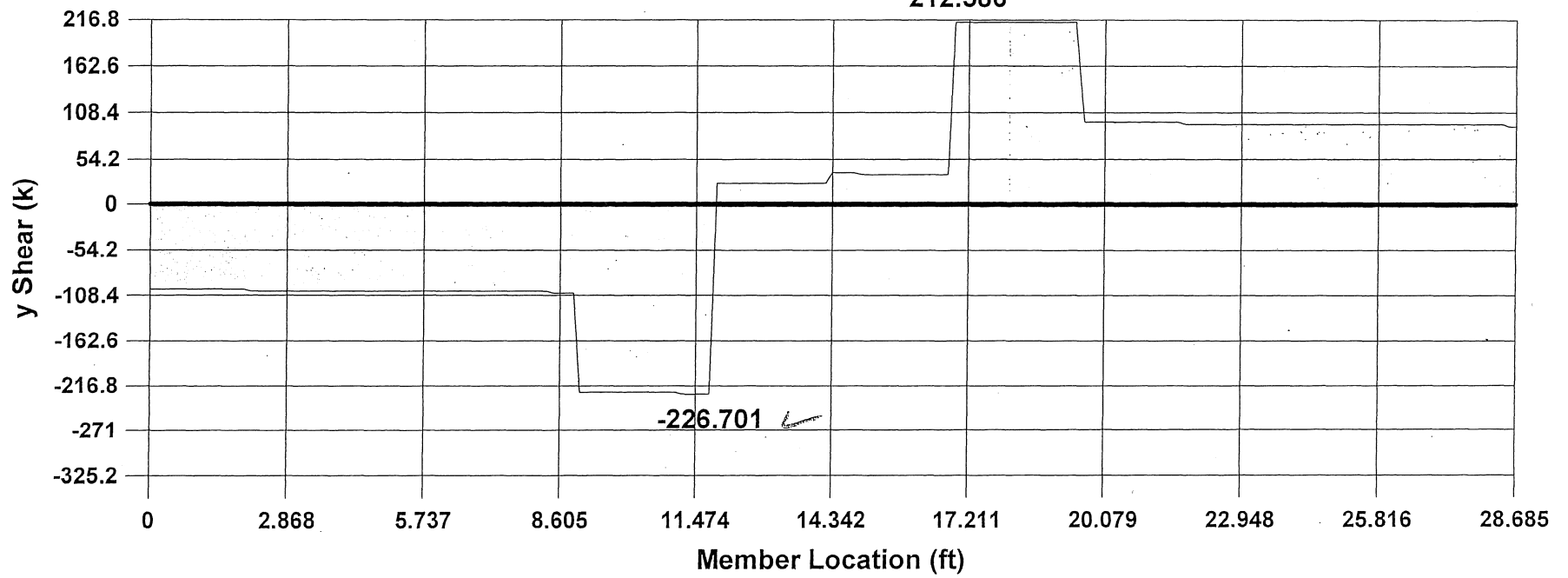
Code Check: **0.000 (bending)**

Report Based On 191 Sections



Member M1 , LC 4: All Dead Loads

212.586 ✓



✓
MEM
S/M/10

8-8

Beam: **M1**

Shape: **BR3A-5a**

Material: **A36 Steel**

Length: **28.685 ft**

I Joint: **N2**

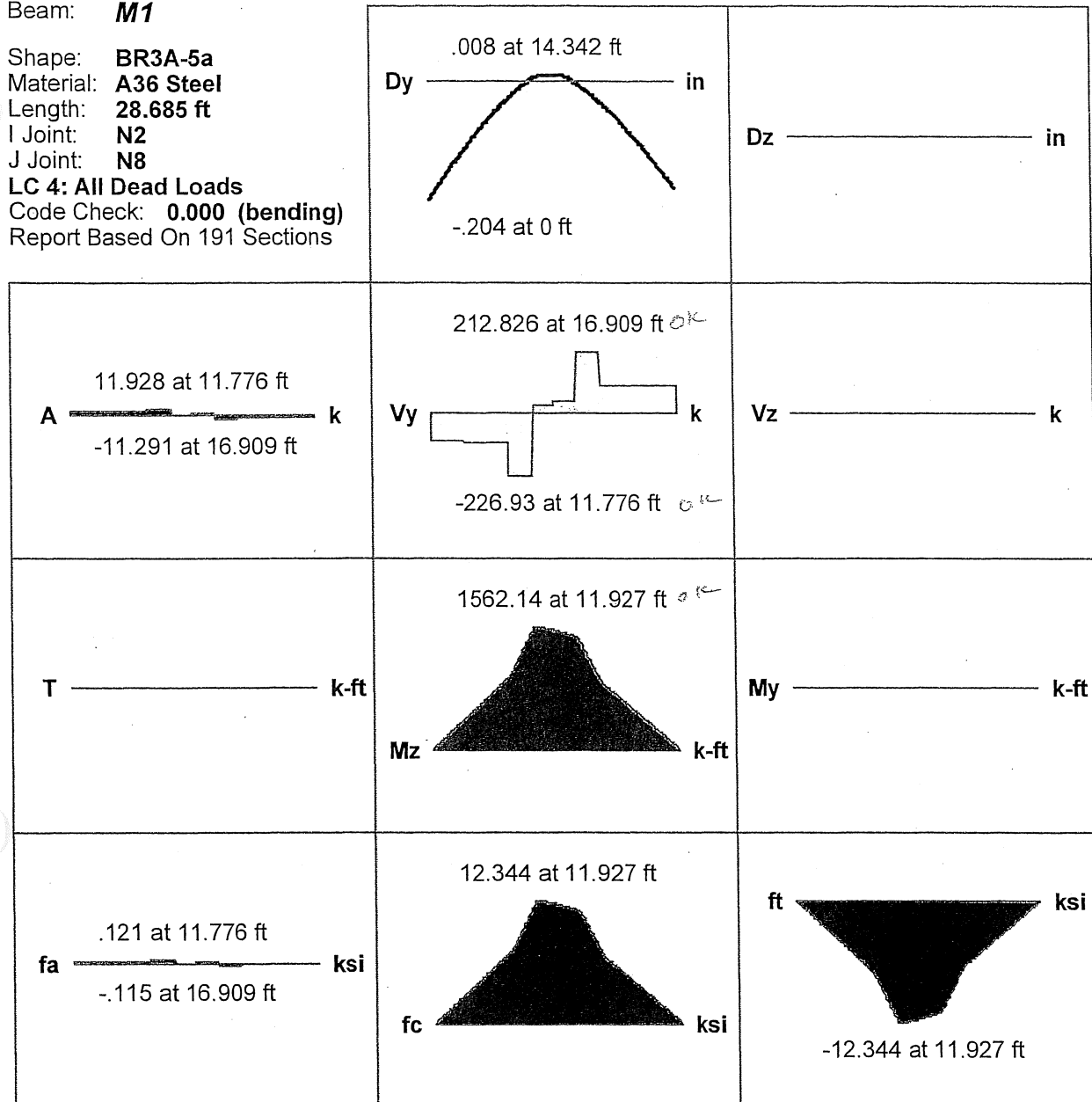
J Joint: **N8**

LC 4: All Dead Loads

Code Check: **0.000 (bending)**

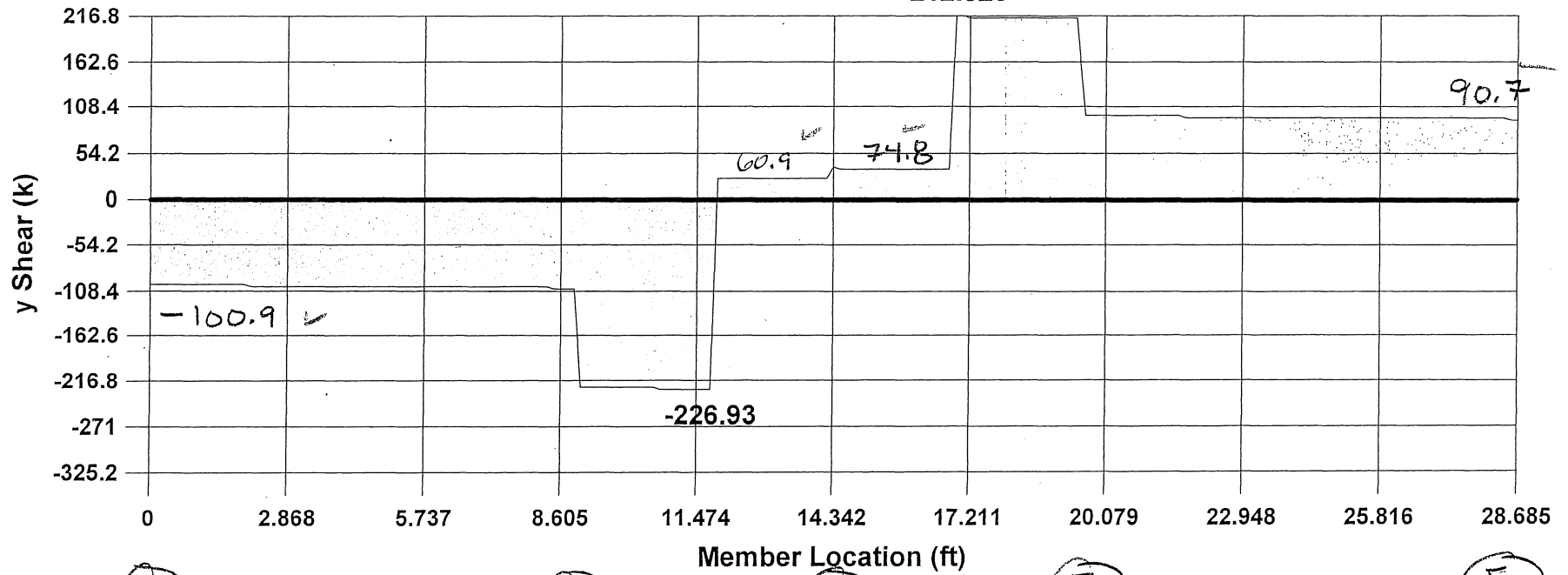
Report Based On 191 Sections

✓CSM
5/11/10



old calc,
but values
still used.

Member M1 , LC 4: All Dead Loads
212.826



(A)
5b

(B)

~~A~~

(D)

~~A~~

(E)
5i

(F)
5b

North Support

South Support
5h

Old calc
but values
still used

✓ 5m
5/11/10

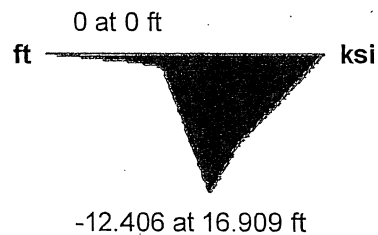
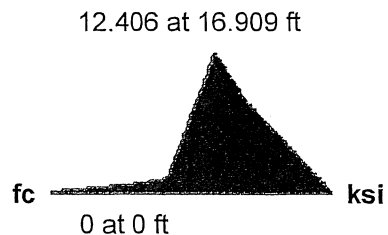
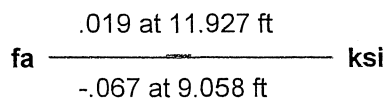
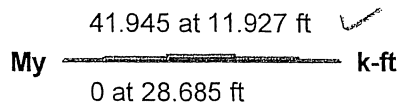
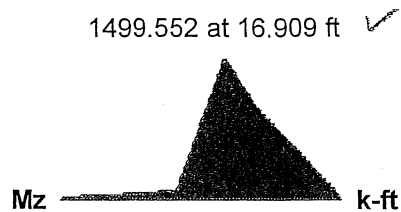
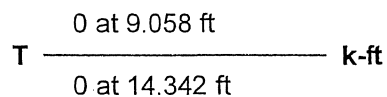
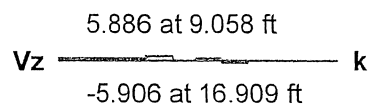
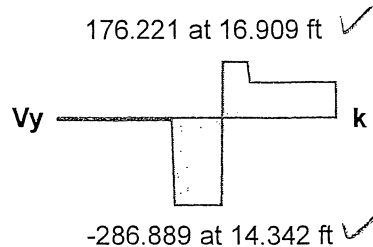
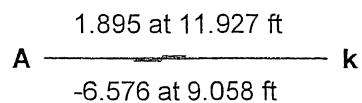
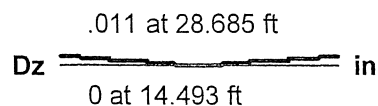
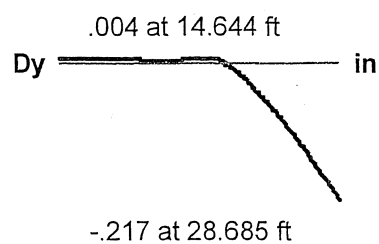
01-S

✓esm
5/11/19Beam: **M1**Shape: **BR3A-5a**Material: **A36 Steel**Length: **28.685 ft**I Joint: **N2**J Joint: **N8**

LC 5: One Lane R

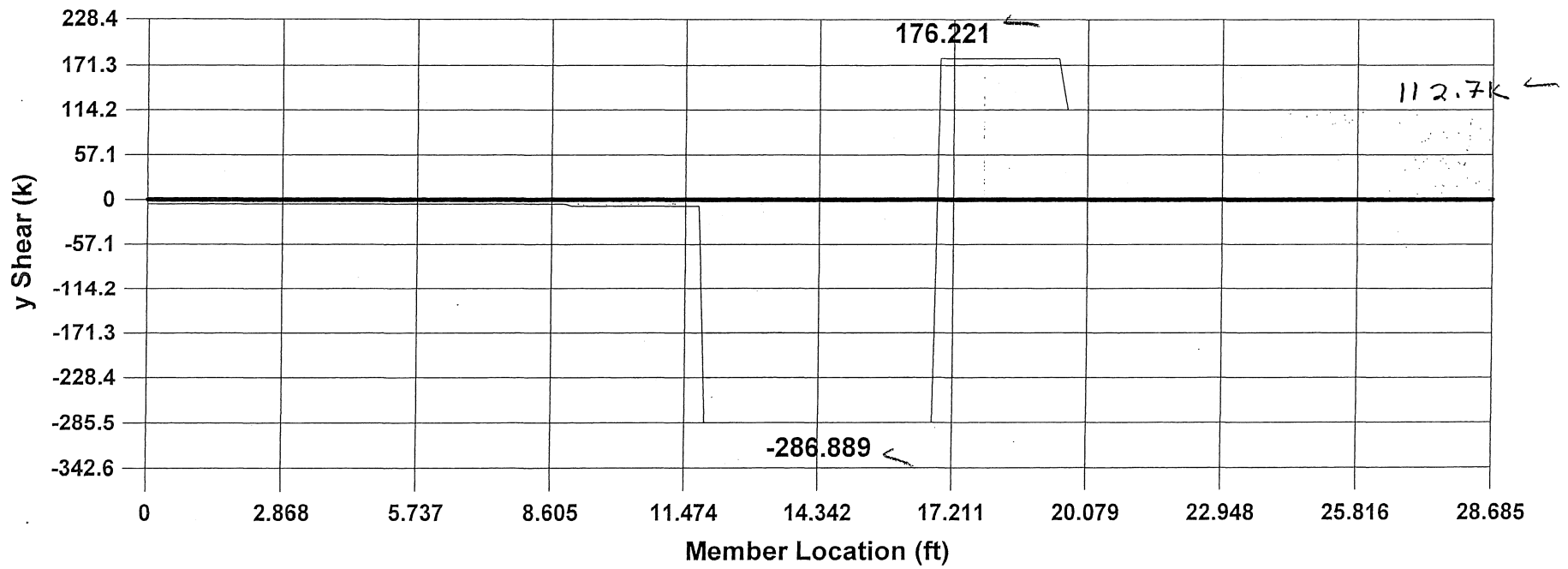
Code Check: **0.000 (bending)**

Report Based On 191 Sections



w/ Girder D.

Member M1 , LC 5: One Lane R

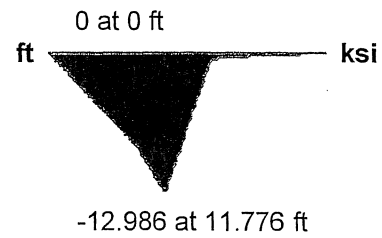
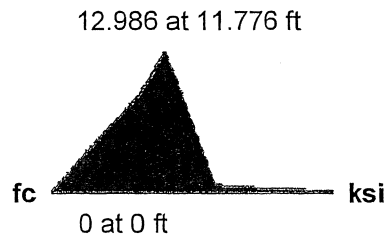
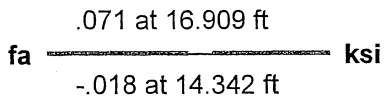
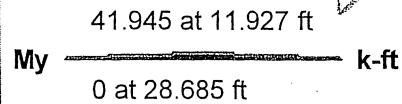
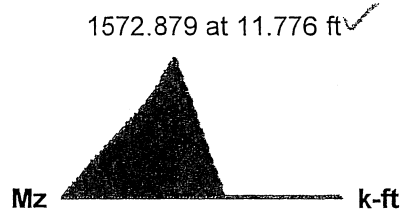
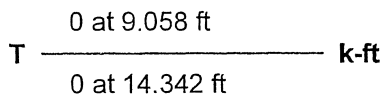
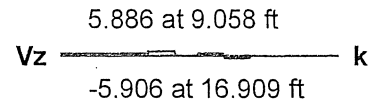
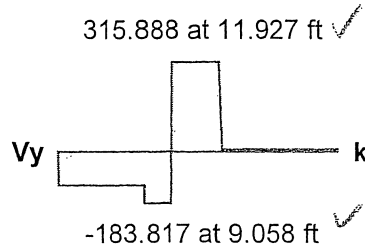
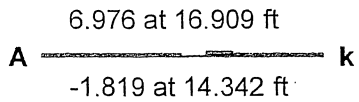
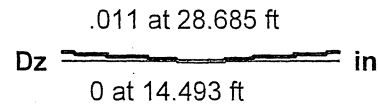
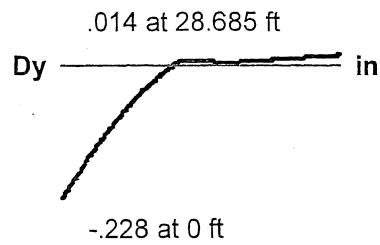


1/5/12
5/11/12
5/11/12

5-12

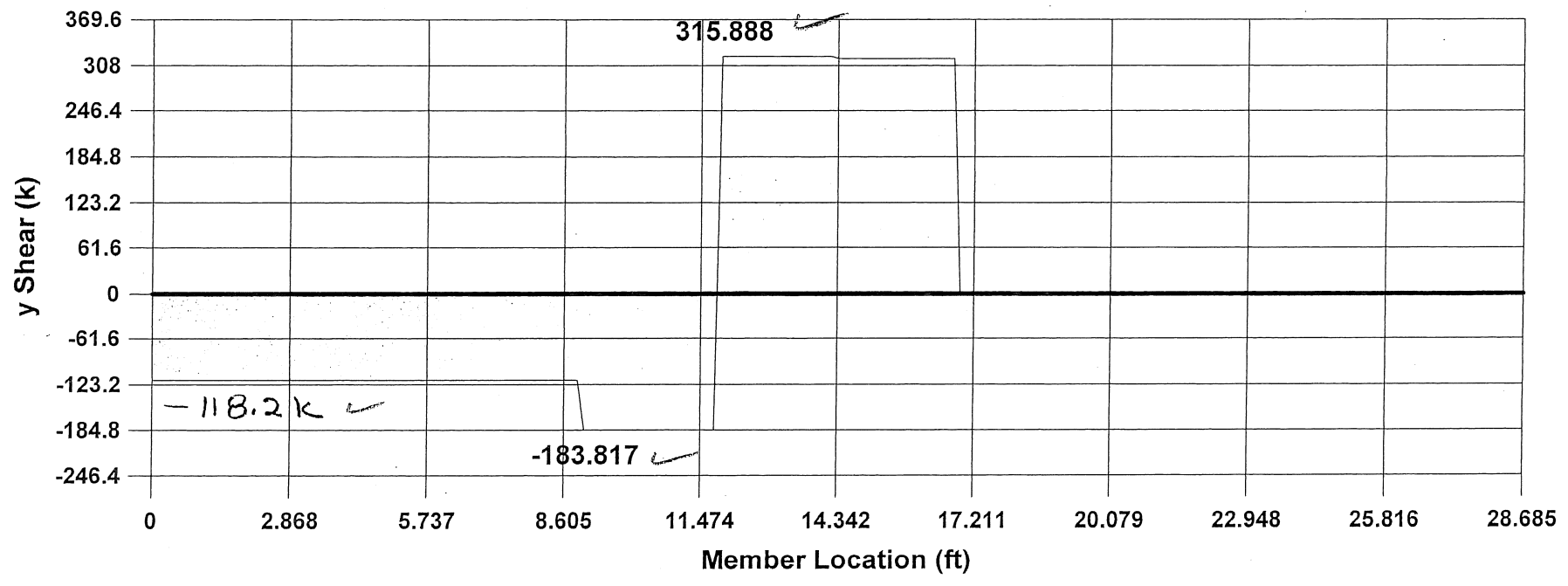
✓
5/11/10Beam: **M1**Shape: **BR3A-5a**Material: **A36 Steel**Length: **28.685 ft**I Joint: **N2**J Joint: **N8****LC 6: One Lane L**Code Check: **0.000 (bending)**

Report Based On 191 Sections



w/ Girder D

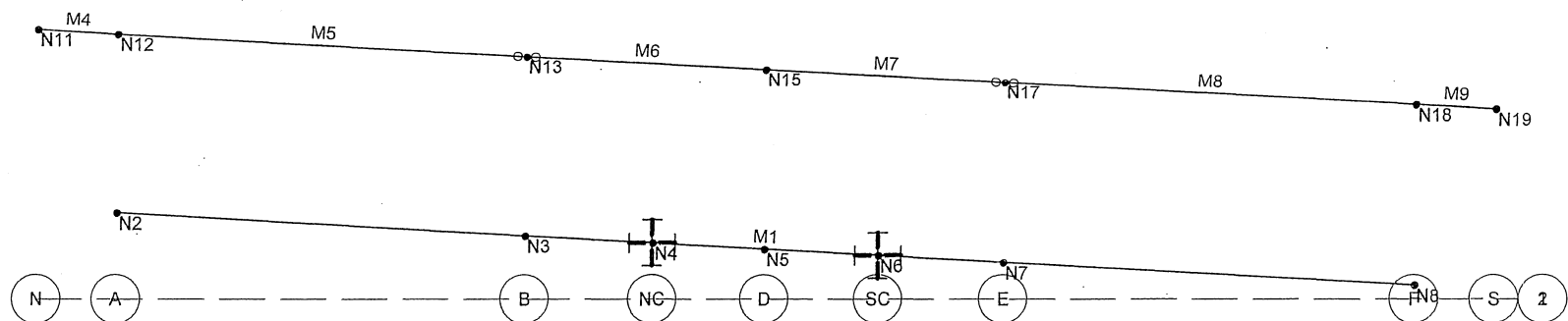
Member M1 , LC 6: One Lane L



LC6M
5/11/10

41-S

698013-3A-P5
Model Input w/ID D



LHB

jdf

090147

Bridge 69801 3A Pier 5 Without Girder D

Jan 19, 2010 at 3:41 PM

090147_3A_P5_Pier_WOGirderD.r3d

Company : LHB
 Designer : jdf
 Job Number : 090147

Bridge 69801 3A Pier 5 Without Girder D

Apr 19, 2010
 2:13 PM
 Checked By: *CJM*

5/11/10

Global

Display Sections for Member Calcs	20
Max Internal Sections for Member Calcs	191
Include Shear Deformation	Yes
Include Warping	No
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Vertical Axis	Y

Hot Rolled Steel Code	AISC : LRFD 13th
Cold Formed Steel Code	AISI 01: ASD
Wood Code	NDS 2005: ASD
Wood Temperature	< 100F
Concrete Code	ACI 2005
Masonry Code	MSJC 05/IBC 06 ASD

Number of Shear Regions	4
Region Spacing Increment (in)	4
Biaxial Column Method	Exact Integration
Parame Beta Factor (PCA)	.65
Concrete Stress Block	Rectangular
Use Cracked Sections	Yes
Bad Framing Warnings	No
Unused Force Warnings	Yes

Footing Overturning Safety Factor	1.5
Check Concrete Bearing	Yes
Self Wt, Overburden in DL for Design	Yes
Footing Concrete Weight	.145 k/ft^3
Footing Concrete f _c	3 ksi
Footing Concrete E _c	4000 ksi
Footing Steel f _y	60 ksi
Minimum Steel	0.0018
Maximum Steel	0.0075
Footing Top Bar	#3
Footing Top Bar Cover	3.5 in
Footing Bottom Bar	#4
Footing Bottom Bar Cover	3.5 in
Pedestal Bar	#3
Pedestal Bar Cover	1.5 in
Pedestal Ties	#3

General Material Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (1/E5 F)	Density[k/ft^3]
1	A36 Steel	29000	11154	.3	.65	.49

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (1/E5 F)	Density[k/ft^3]	Yield[ksi]
1	A36	29000	11154	.3	.65	.49	36

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rules	A [in^2]	I _{yy} [in^4]	I _{zz} [in^4]	J [in^4]
1	Slab	W8X40	Beam	None	A36	Typical	11.7	49.1	146	1.12

5/11/10

Member Primary Data

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1	N2	N8			BR3A-5a	Beam	None	A36 Steel	Default
2	M4	N11	N12			Slab	Beam	None	A36	Typical
3	M5	N12	N13			Slab	Beam	None	A36	Typical
4	M6	N13	N15			Slab	Beam	None	A36	Typical
5	M7	N15	N17			Slab	Beam	None	A36	Typical
6	M8	N17	N18			Slab	Beam	None	A36	Typical
7	M9	N18	N19			Slab	Beam	None	A36	Typical

Member Advanced Data

	Label	I Release	J Release	I Offset[in]	J Offset[in]	T/C Only	Physical	TOM	Inactive
1	M1						Yes	Yes	
2	M4						Yes	Yes	
3	M5		BenPIN				Yes	Yes	
4	M6	BenPIN					Yes	Yes	
5	M7		BenPIN				Yes	Yes	
6	M8	BenPIN					Yes	Yes	
7	M9						Yes	Yes	

Joint Coordinates and Temperatures

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
1	N2	1.75	1.902	0	0	
2	N3	10.75	1.398	0	0	
3	N4	13.57	1.24	0	0	
4	N5	16.05	1.1	0	0	
5	N6	18.57	.96	0	0	
6	N7	21.34	.805	0	0	
7	N8	30.39	.298	0	0	
8	N11	0	6	0	0	
9	N12	1.75	5.902	0	0	
10	N13	10.75	5.398	0	0	
11	N15	16.05	5.1	0	0	
12	N17	21.34	4.805	0	0	
13	N18	30.39	4.298	0	0	
14	N19	32.14	4.2	0	0	

Joint Boundary Conditions

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot.[k-ft/rad]	Y Rot.[k-ft/rad]	Z Rot.[k-ft/rad]	Footings
1	N4	Reaction	Reaction	Reaction	Reaction			
2	N6	Reaction	Reaction	Reaction	Reaction			
3	N12	SlaveN2	SlaveN2	SlaveN2	SlaveN2			
4	N13	SlaveN3	SlaveN3	SlaveN3	SlaveN3			
5	N17	SlaveN7	SlaveN7	SlaveN7	SlaveN7			
6	N18	SlaveN8	SlaveN8	SlaveN8	SlaveN8			

Joint Loads and Enforced Displacements (BLC 7 : Centrifigul Force)

	Joint Label	L,D,M	Direction	Magnitude[(k.k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Y	-9.25
2	N3	L	Y	-3.43
3	N2	L	X	-6.1
4	N3	L	X	-6.1
5	N5	L	X	-6.1

5/11/10

Joint Loads and Enforced Displacements (BLC 7 : Centrifigal Force) (Continued)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
6	N7	L	X	-6.1
7	N8	L	X	-6.1

Joint Loads and Enforced Displacements (BLC 8 : Noncomp Dead)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Y	-80.33
2	N3	L	Y	-97.05
3	N5	L	Y	10.74
4	N7	L	Y	-93.64
5	N8	L	Y	-71.74

Joint Loads and Enforced Displacements (BLC 9 : Superimposed Dead)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Y	-22.19
2	N3	L	Y	-26.5
3	N5	L	Y	.16
4	N7	L	Y	-26.09
5	N8	L	Y	-20.58

Joint Loads and Enforced Displacements (BLC 10 : MDX Bracing Weight)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N2	L	Y	1.48
2	N3	L	Y	2.76
3	N5	L	Y	2.57
4	N7	L	Y	2.75
5	N8	L	Y	1.47

Member Point Loads (BLC 2 : Lanes Seperate)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
1	M4	Y	-2.6	0
2	M4	Y	-5.19	1
3	M5	Y	-5.19	.25
4	M5	Y	-5.19	1.25
5	M5	Y	-5.19	2.25
6	M5	Y	-5.19	3.25
7	M5	Y	-5.19	4.25
8	M5	Y	-5.19	5.25
9	M5	Y	-5.19	6.25
10	M5	Y	-5.19	7.25
11	M5	Y	-2.6	8.25
12	M8	Y	-2.6	.8
13	M8	Y	-5.19	1.8
14	M8	Y	-5.19	2.8
15	M8	Y	-5.19	3.8
16	M8	Y	-5.19	4.8
17	M8	Y	-5.19	5.8
18	M8	Y	-5.19	6.8
19	M8	Y	-5.19	7.8
20	M8	Y	-5.19	8.8
21	M9	Y	-5.19	.75
22	M9	Y	-2.6	1.75

Member Point Loads (BLC 3 : Lanes Together R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft,%]
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5/11/10

Member Point Loads (BLC 3 : Lanes Together R) (Continued)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M5	Y	-2.6	8.39
2	M6	Y	-5.19	.39
3	M6	Y	-5.19	1.39
4	M6	Y	-5.19	2.39
5	M6	Y	-5.19	3.39
6	M6	Y	-5.19	4.39
7	M7	Y	-5.19	.09
8	M7	Y	-5.19	1.09
9	M7	Y	-5.19	2.09
10	M7	Y	-5.19	3.09
11	M7	Y	-2.6	4.09
12	M8	Y	-2.6	.8
13	M8	Y	-5.19	1.8
14	M8	Y	-5.19	2.8
15	M8	Y	-5.19	3.8
16	M8	Y	-5.19	4.8
17	M8	Y	-5.19	5.8
18	M8	Y	-5.19	6.8
19	M8	Y	-5.19	7.8
20	M8	Y	-5.19	8.8
21	M9	Y	-5.19	.75
22	M9	Y	-2.6	1.75

Member Point Loads (BLC 4 : Trucks Seperate)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M5	Y	-35.65	.25
2	M5	Y	-35.65	6.25
3	M8	Y	-35.65	2.8
4	M8	Y	-35.65	8.8

Member Point Loads (BLC 5 : Trucks Together R)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M6	Y	-35.65	3.39
2	M7	Y	-35.65	4.09
3	M8	Y	-35.65	2.8
4	M8	Y	-35.65	8.8

Member Point Loads (BLC 6 : Trucks Together L)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M5	Y	-35.65	.25
2	M5	Y	-35.65	6.25
3	M6	Y	-35.65	1.25
4	M7	Y	-35.65	1.95

Member Point Loads (BLC 11 : Lanes Together L)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M4	Y	-2.6	0
2	M4	Y	-5.19	1
3	M5	Y	-5.19	.25
4	M5	Y	-5.19	1.25
5	M5	Y	-5.19	2.25
6	M5	Y	-5.19	3.25
7	M5	Y	-5.19	4.25
8	M5	Y	-5.19	5.25
9	M5	Y	-5.19	6.25
10	M5	Y	-5.19	7.25

5/11/10

Member Point Loads (BLC 11 : Lanes Together L) (Continued)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft,%]
11	M5	Y	-2.6	8.25
12	M6	Y	-2.6	1.75
13	M6	Y	-5.19	2.75
14	M6	Y	-5.19	3.75
15	M6	Y	-5.19	4.75
16	M7	Y	-5.19	.45
17	M7	Y	-5.19	1.45
18	M7	Y	-5.19	2.45
19	M7	Y	-5.19	3.45
20	M7	Y	-5.19	4.45
21	M8	Y	-5.19	.16
22	M8	Y	-2.6	1.16

Member Point Loads (BLC 13 : Lane R)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft,%]
1	M8	Y	-2.6	.8
2	M8	Y	-5.19	1.8
3	M8	Y	-5.19	2.8
4	M8	Y	-5.19	3.8
5	M8	Y	-5.19	4.8
6	M8	Y	-5.19	5.8
7	M8	Y	-5.19	6.8
8	M8	Y	-5.19	7.8
9	M8	Y	-5.19	8.8
10	M9	Y	-5.19	.75
11	M9	Y	-2.6	1.75

Member Point Loads (BLC 14 : Lane L)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft,%]
1	M4	Y	-2.6	0
2	M4	Y	-5.19	1
3	M5	Y	-5.19	.25
4	M5	Y	-5.19	1.25
5	M5	Y	-5.19	2.25
6	M5	Y	-5.19	3.25
7	M5	Y	-5.19	4.25
8	M5	Y	-5.19	5.25
9	M5	Y	-5.19	6.25
10	M5	Y	-5.19	7.25
11	M5	Y	-2.6	8.25

Member Point Loads (BLC 15 : Truck R)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft,%]
1	M8	Y	-35.65	2.8
2	M8	Y	-35.65	8.8

Member Point Loads (BLC 16 : Truck L)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft,%]
1	M5	Y	-35.65	.25
2	M5	Y	-35.65	6.25

Member Distributed Loads (BLC 1 : Pier Cap Weight)

	Member Label	Direction	Start Magnitude[k/ft,d...]	End Magnitude[k/ft,d...]	Start Location[ft,%]	End Location[ft,%]
1	M1	Y	-.355	-.489	0	10.3

T-6

Company : LHB
 Designer : jdf
 Job Number : 090147

Bridge 69801 3A Pier 5 Without Girder D

Apr 19, 2010
 2:13 PM
 Checked By: *CSM*

5/11/10

Member Distributed Loads (BLC 1 : Pier Cap Weight) (Continued)

	Member Label	Direction	Start Magnitude[k/ft.d...]	End Magnitude[k/ft.d...]	Start Location[ft.%]	End Location[ft.%]
2	M1	Y	-.598	-.576	10.3	18.4
3	M1	Y	-.467	-.355	18.4	100

Member Distributed Loads (BLC 12 : Braking Force)

	Member Label	Direction	Start Magnitude[k/ft.d...]	End Magnitude[k/ft.d...]	Start Location[ft.%]	End Location[ft.%]
1	M4	Z	.731	.731	0	0
2	M5	Z	.731	.731	0	0
3	M6	Z	.731	.731	0	0
4	M7	Z	.731	.731	0	0
5	M8	Z	.731	.731	0	0
6	M9	Z	.731	.731	0	0

Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distributed Area (Me... Surface (...)
1	Pier Cap Weight	DL						3
2	Lanes Seperate	LL					22	
3	Lanes Together R	LL					22	
4	Trucks Seperate	LL					4	
5	Trucks Together R	LL					4	
6	Trucks Together L	LL					4	
7	Centrifigual Force	LL				7		
8	Noncomp Dead	DL				5		
9	Superimposed Dead	DL				5		
10	MDX Bracing Weight	DL				5		
11	Lanes Together L	LL					22	
12	Braking Force	LL						6
13	Lane R	LL					11	
14	Lane L	LL					11	
15	Truck R	LL					2	
16	Truck L	LL					2	

Load Combinations

	Description	Sol...PD...SR...	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor	BLC Factor
1	Loads Seperate		2	1	4	1.33	7	1	12	1	
2	Loads Together L		11	1	6	1.33	7	1	12	1	
3	Loads Together R		3	1	5	1.33	7	1	12	1	
4	All Dead Loads		DL	1							
5	One Lane R	Yes	13	1.2	15	1.596	7	.6	12	.6	
6	One Lane L	Yes	14	1.2	16	1.596	7	.6	12	.6	

T-7



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250 3rd Avenue North, Suite 450
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612 338-2029
Fax 612 338-2088

PROJECT MnDOT SS-69801J-3A.P5-Wo Girder D Loadings.
PROJECT # 090147 DATE 4/19/10 BY jdf SHEET NO. OF

VCSM
5/11/10

Basic Load Cases for Pier 5 without Girder D
are the same as Pier 5 with Girder D.

See Pier 5 with Girder D for print-outs of
loadings.

698013-3A-P5
Model Results w/10 0

Beam: **M1**

Shape: **BR3A-5a**

Material: **A36 Steel**

Length: **28.685 ft**

I Joint: **N2**

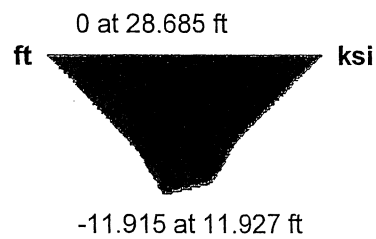
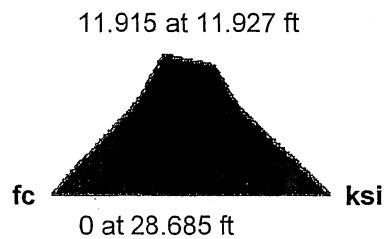
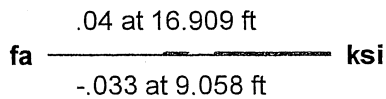
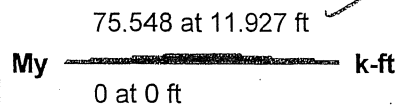
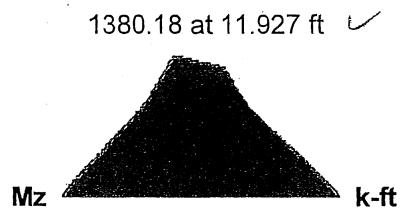
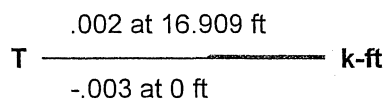
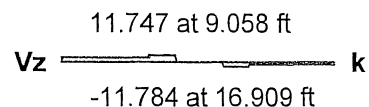
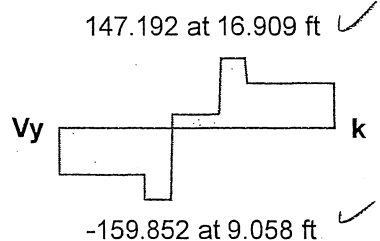
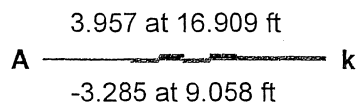
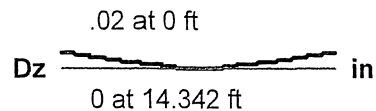
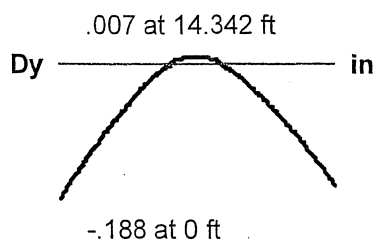
J Joint: **N8**

LC 1: Loads Seperate

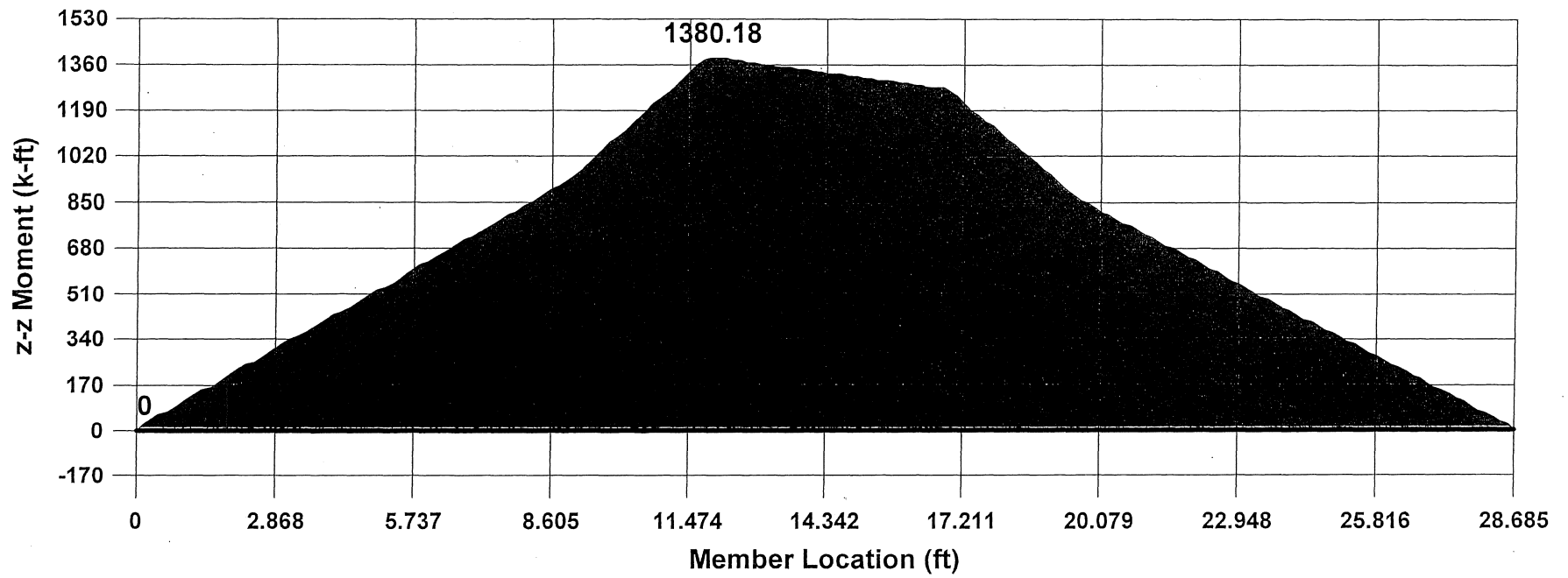
Code Check: **0.000 (bending)**

Report Based On 191 Sections

✓CSM
Studio



Member M1 , LC 1: Loads Seperate

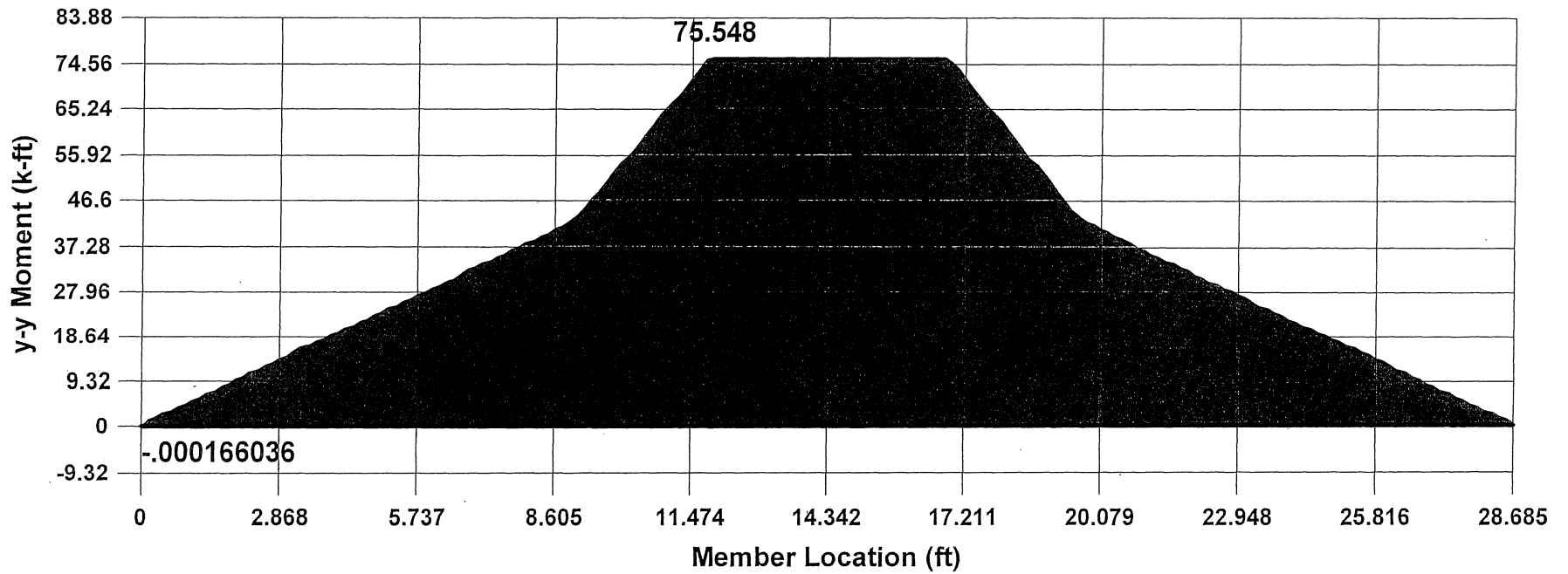


$10.26' = 1131 \text{ kip}\cdot\text{ft}$ - section - f ✓
 $18.42' = 1030 \text{ kip}\cdot\text{ft}$ - section - c ✓

VCSM
 5/11/10

U-2

Member M1 , LC 1: Loads Seperate



10.26' = 57.1 kip·ft - section - f ✓
 18.42' = 56.9 kip·ft - section - c ✓

10/31/10
 5/11/10

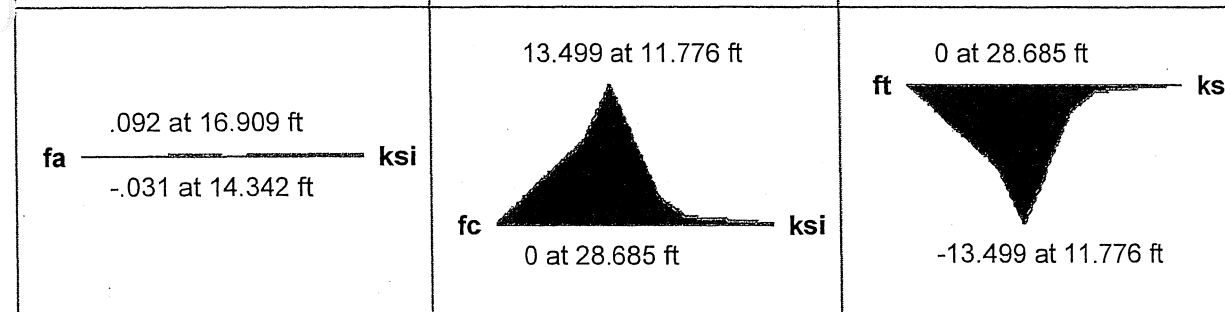
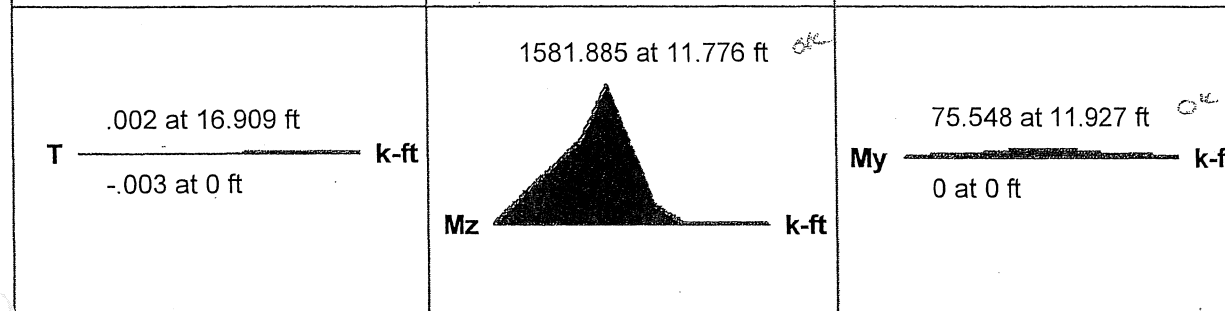
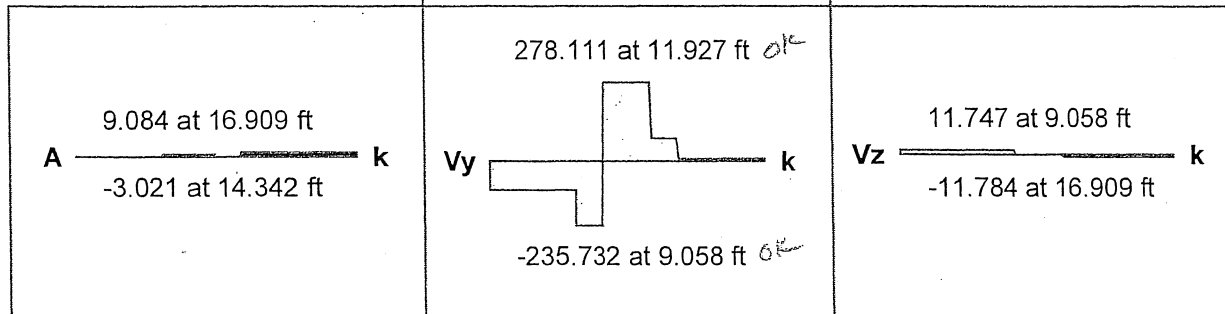
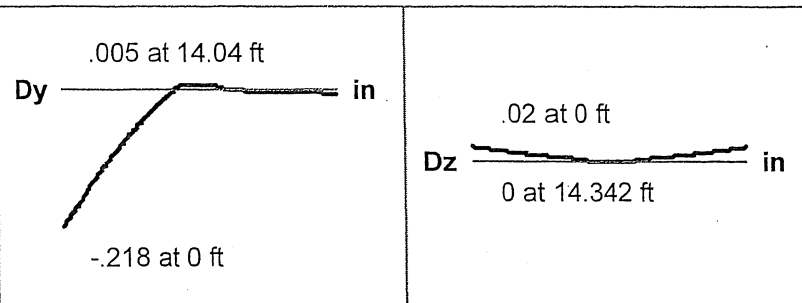
U-3

Beam: **M1**

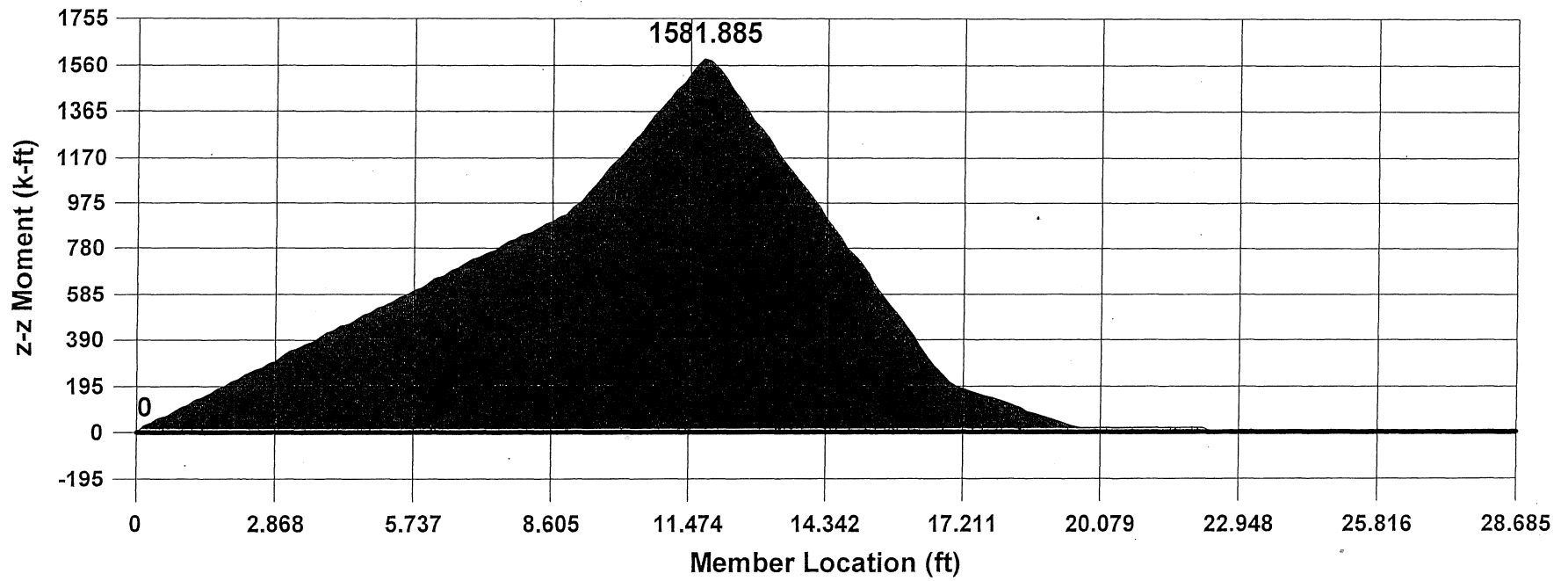
Shape: **BR3A-5a**
Material: **A36 Steel**
Length: **28.685 ft**
I Joint: **N2**
J Joint: **N8**

LC 2: Loads Together L
Code Check: **0.000 (bending)**
Report Based On 191 Sections

VCSM
5/11/10



Member M1 , LC 2: Loads Together L



10.26' = 1226 kip.ft - section f ^{ok}
 18.42' = 92.7 kip.ft - section c ^{ok}

5/11/10
 JCSM

U-S

Beam: **M1**

Shape: **BR3A-5a**

Material: **A36 Steel**

Length: **28.685 ft**

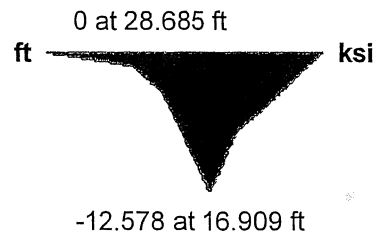
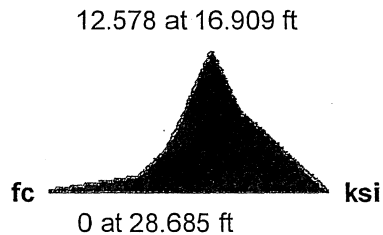
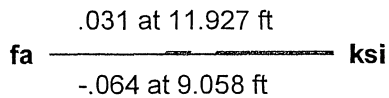
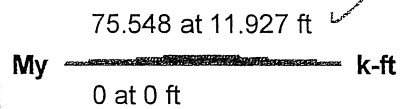
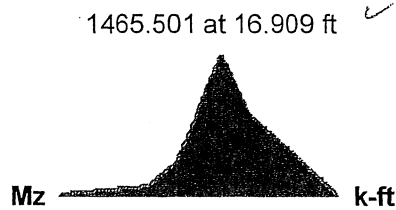
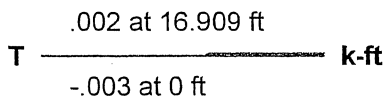
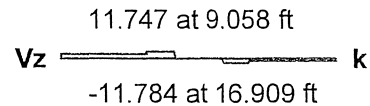
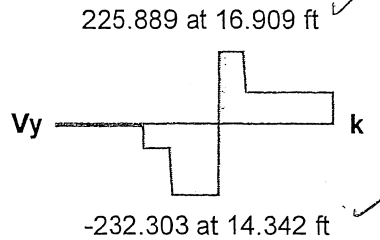
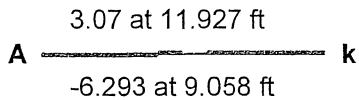
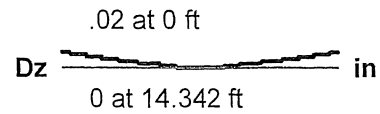
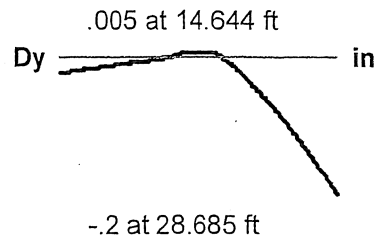
I Joint: **N2**

J Joint: **N8**

LC 3: Loads Together R

Code Check: **0.000 (bending)**

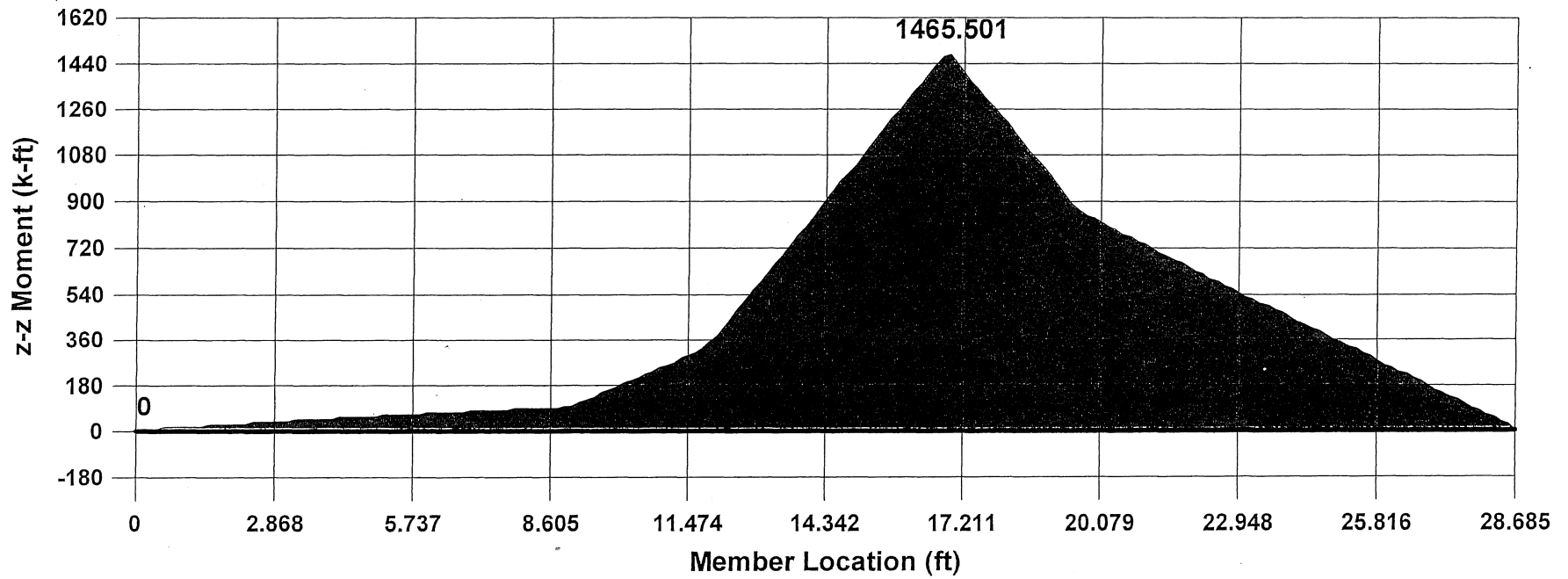
Report Based On 191 Sections



✓
5/11/10

U-6

Member M1 , LC 3: Loads Together R



10.26' = 189.6 kip.ft - section f ✓
 18.42' = 1124 kip.ft - section c ✓

LC3M
 5/11/0

U7

Beam: **M1**

Shape: **BR3A-5a**

Material: **A36 Steel**

Length: **28.685 ft**

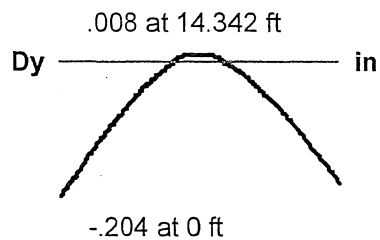
I Joint: **N2**

J Joint: **N8**

LC 4: All Dead Loads

Code Check: **0.000 (bending)**

Report Based On 191 Sections



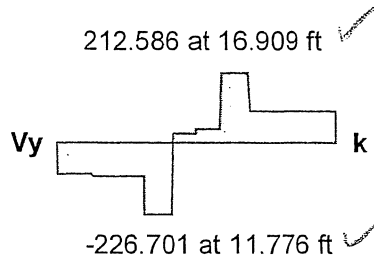
Dz _____ in

VCSM
5/11/10

12.667 at 11.776 ft

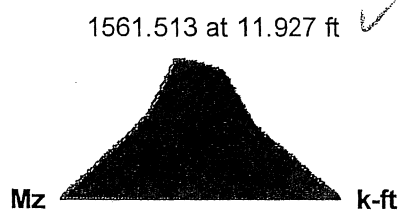
A _____ k

-11.936 at 16.909 ft



Vz _____ k

T _____ k-ft

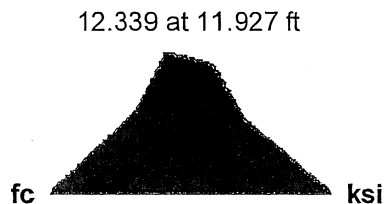


My _____ k-ft

.129 at 11.776 ft

fa _____ ksi

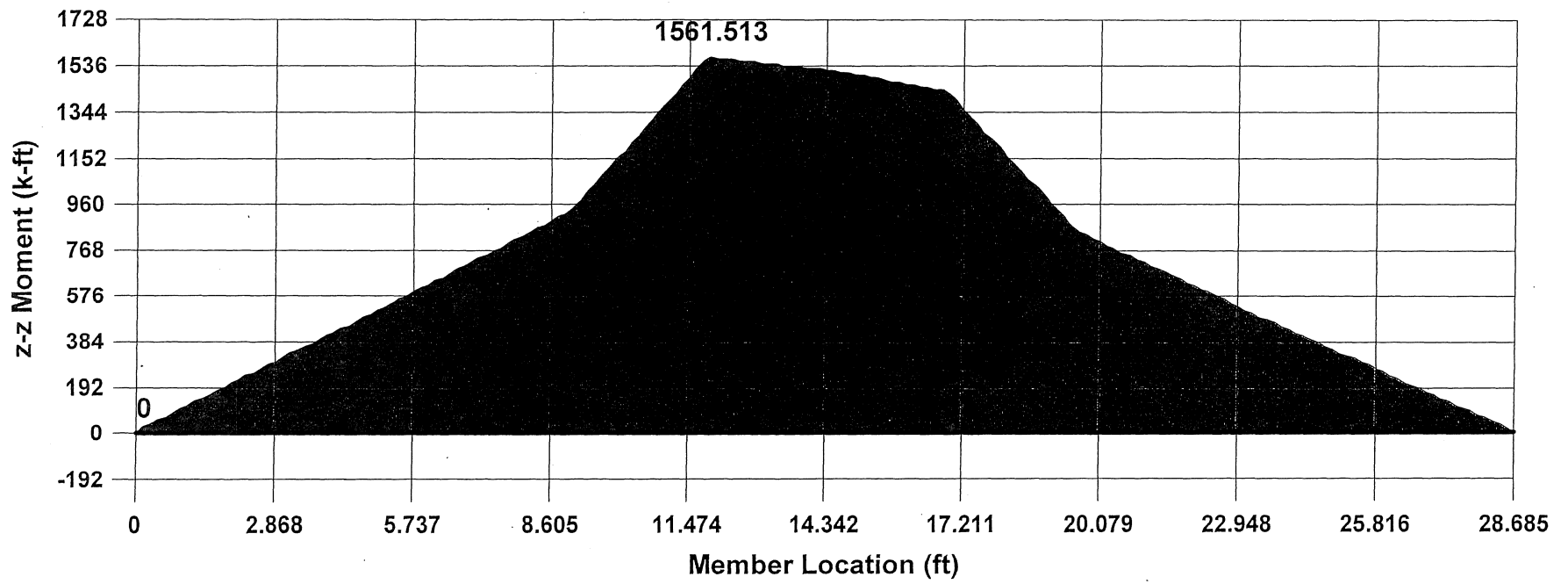
-.121 at 16.909 ft



ft _____ ksi

-12.339 at 11.927 ft

Member M1 , LC 4: All Dead Loads



LC5M
5/11/10

U-9

Beam: **M1**

Shape: **BR3A-5a**

Material: **A36 Steel**

Length: **28.685 ft**

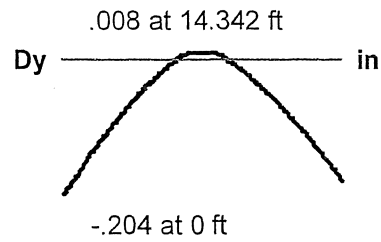
I Joint: **N2**

J Joint: **N8**

LC 4: All Dead Loads

Code Check: **0.000 (bending)**

Report Based On 191 Sections



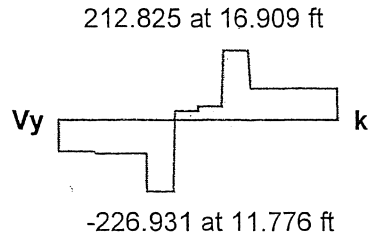
Dz _____ in

OK
1/5/54
5/11/10

A _____ k

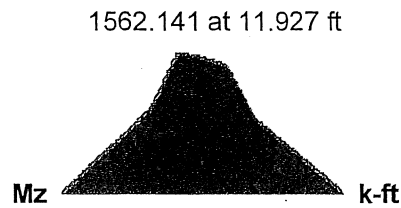
12.68 at 11.776 ft

-11.949 at 16.909 ft



Vz _____ k

T _____ k-ft

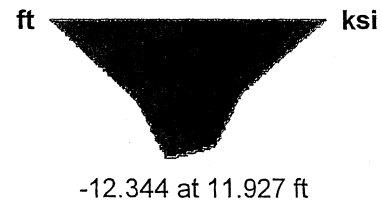
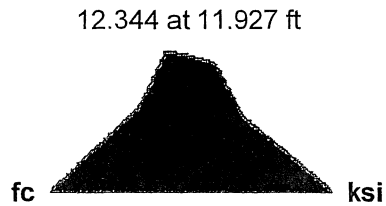


My _____ k-ft

fa _____ ksi

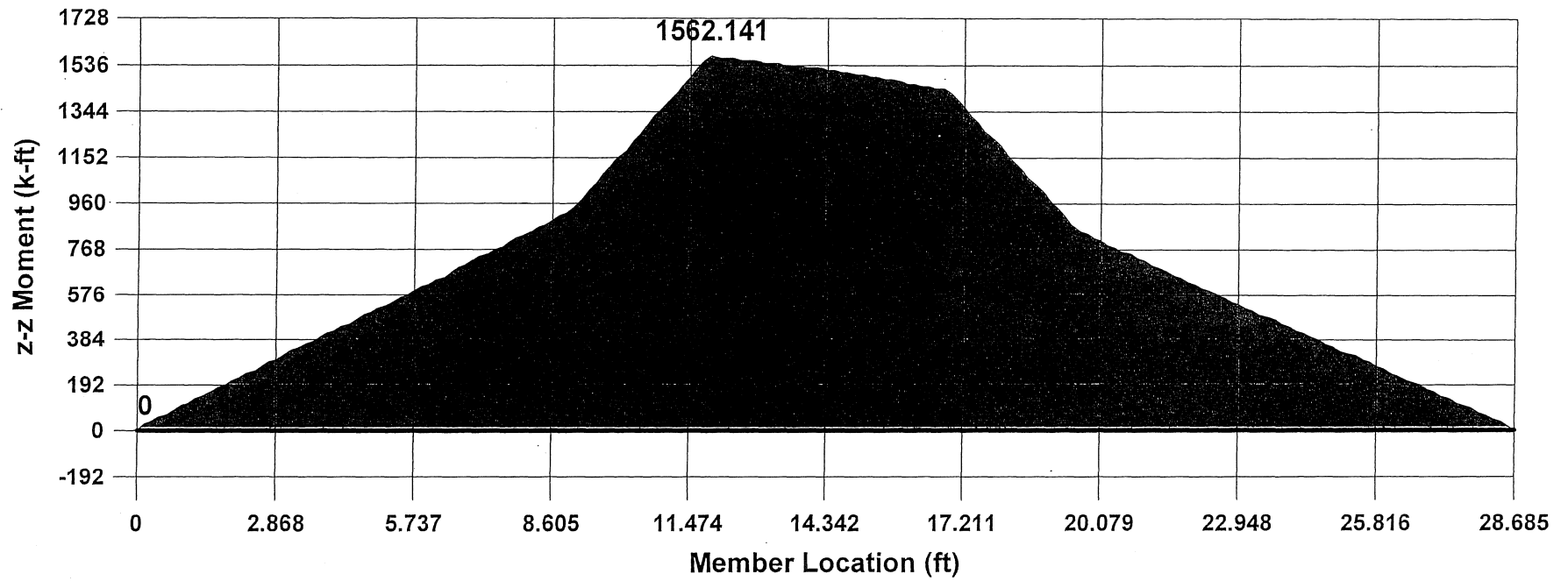
.129 at 11.776 ft

-.121 at 16.909 ft



Old; but
values are
used

Member M1 , LC 4: All Dead Loads



10.26' = 1268 kip.ft - Section - f
 18.42' = 1093 kip.ft - Section - c

10/10/10
 VCM

Old, but
 values
 used.

U-11

w/o Girder D (moment)

✓ 5/11/10

Beam: **M1**

Shape: **BR3A-5a**

Material: **A36 Steel**

Length: **28.685 ft**

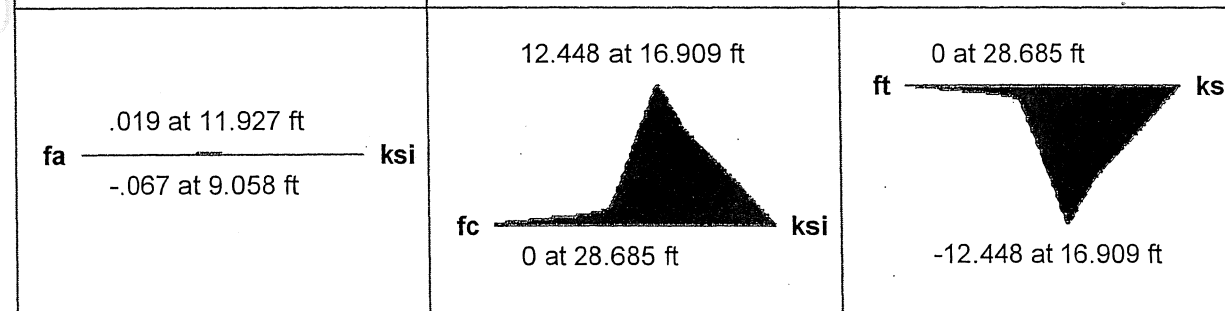
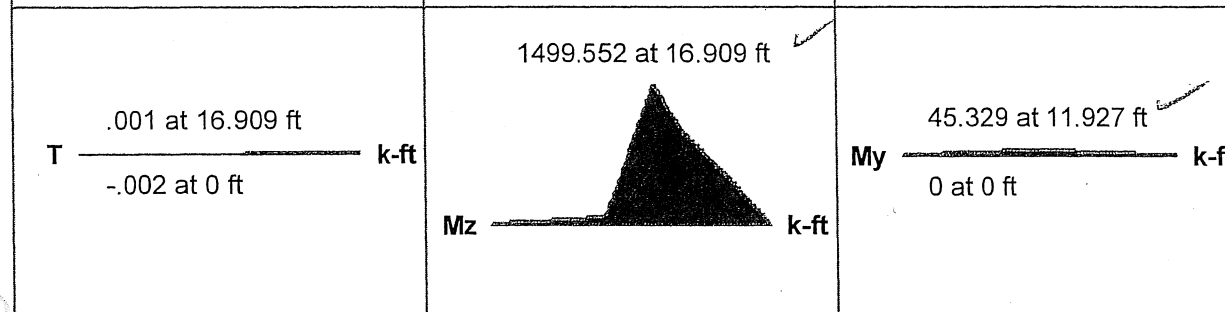
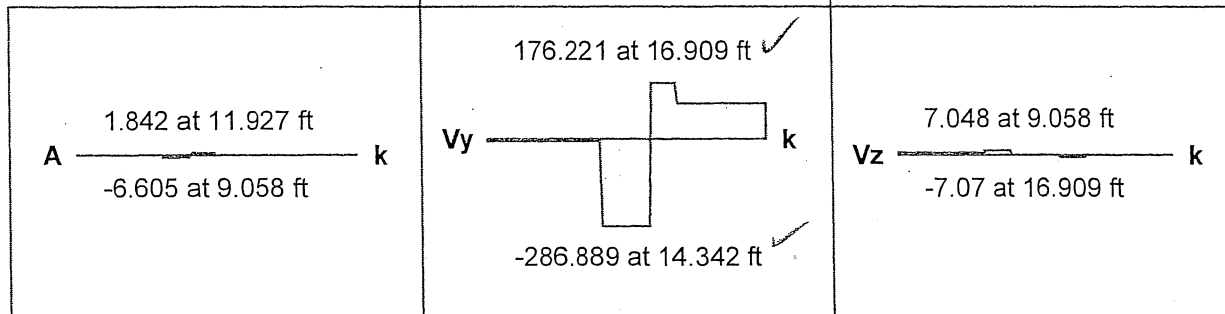
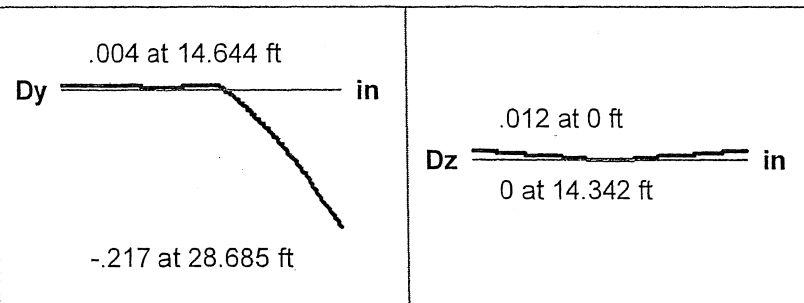
I Joint: **N2**

J Joint: **N8**

LC 5: One Lane R

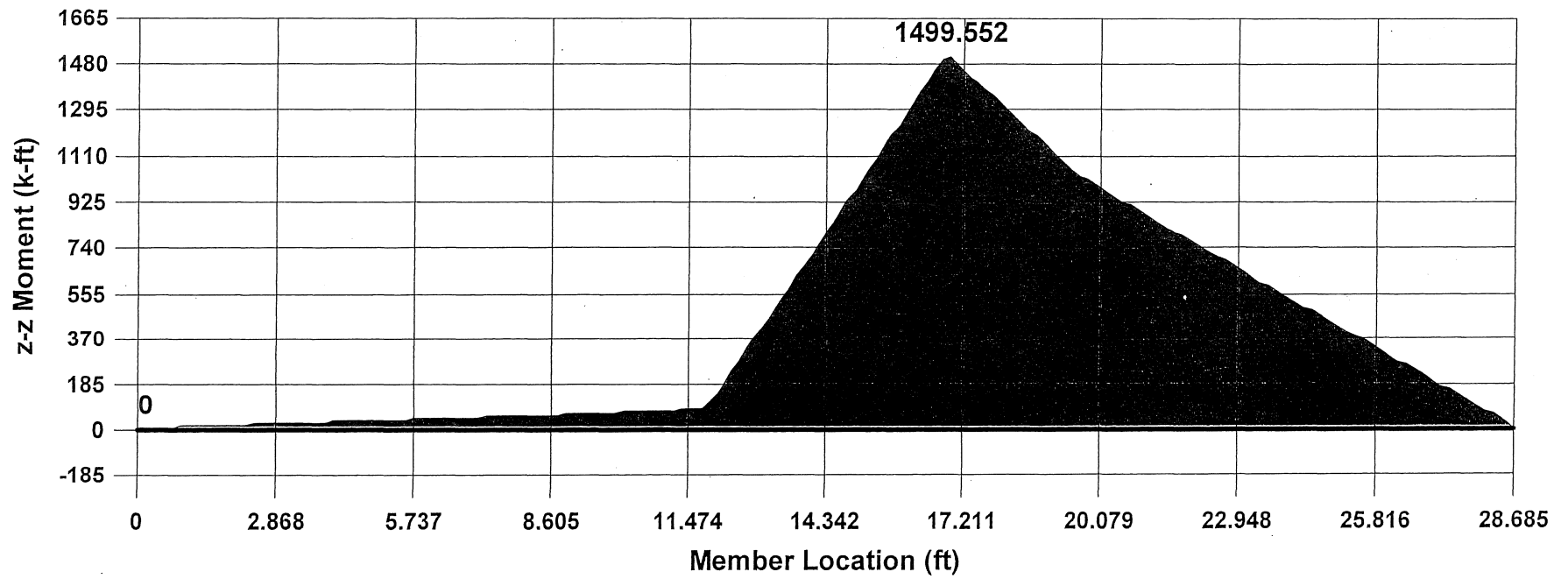
Code Check: **0.000 (bending)**

Report Based On 191 Sections



w/o Girder D

Member M1, LC 5: One Lane R



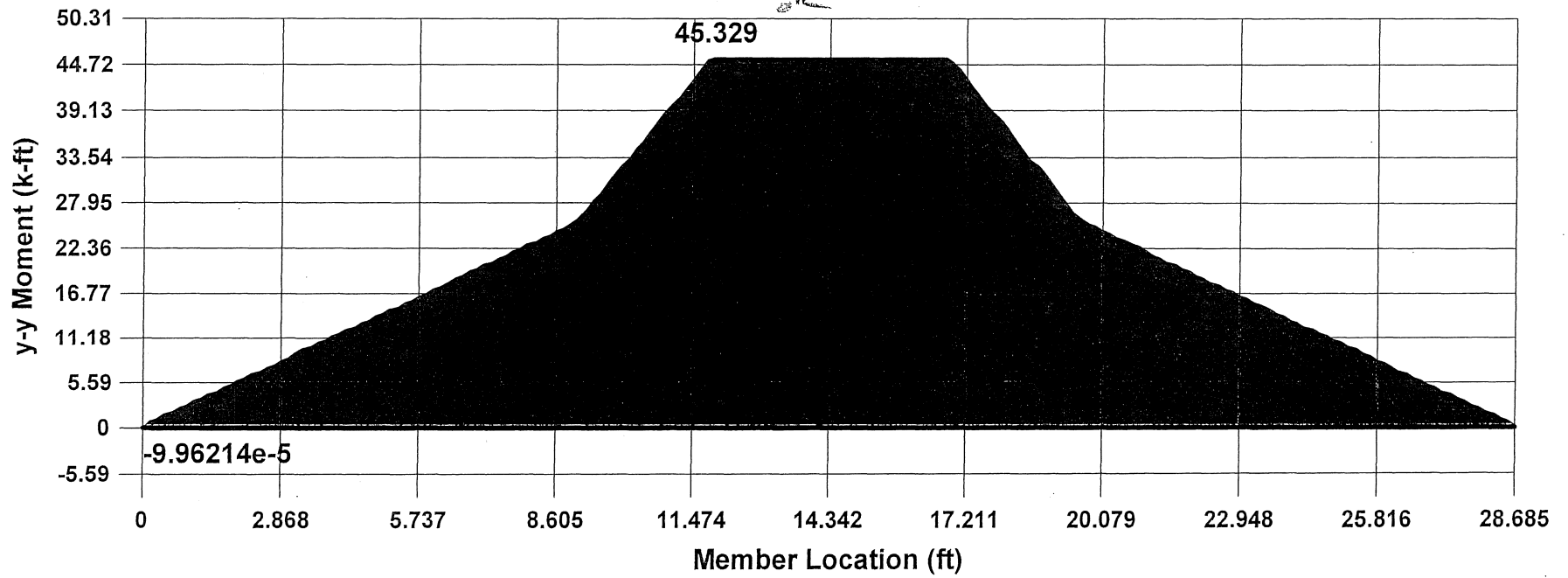
18.42' → section-c → 1233.5 k.ft ←

✓
5/11/10

U-13

w/o Girder D

Member M1 , LC 5: One Lane R



18.42' → section -c → 34.2 k·p·ft

✓
CSM
5/11/10

U-14

w/o Girder D (moment)

✓CSM
5/11/10

Beam: **M1**

Shape: **BR3A-5a**

Material: **A36 Steel**

Length: **28.685 ft**

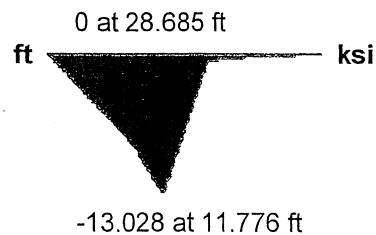
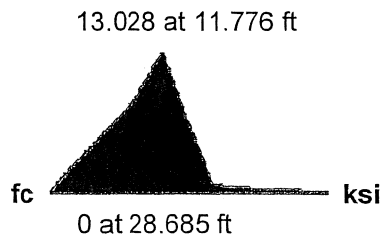
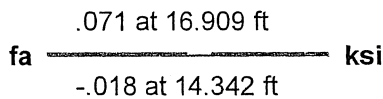
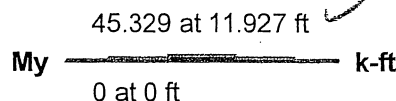
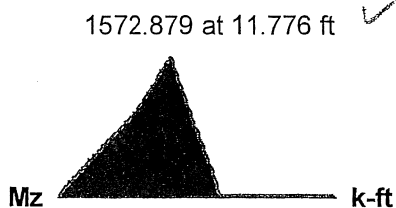
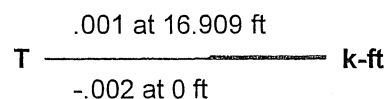
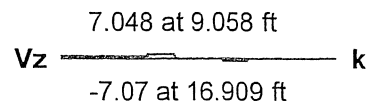
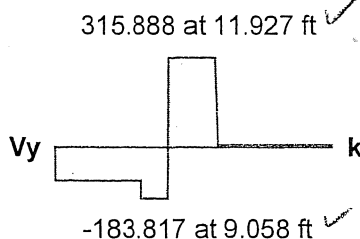
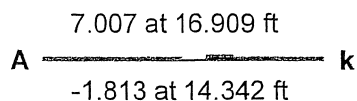
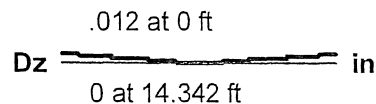
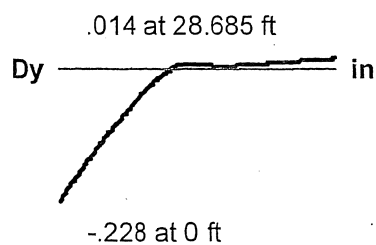
I Joint: **N2**

J Joint: **N8**

LC 6: **One Lane L**

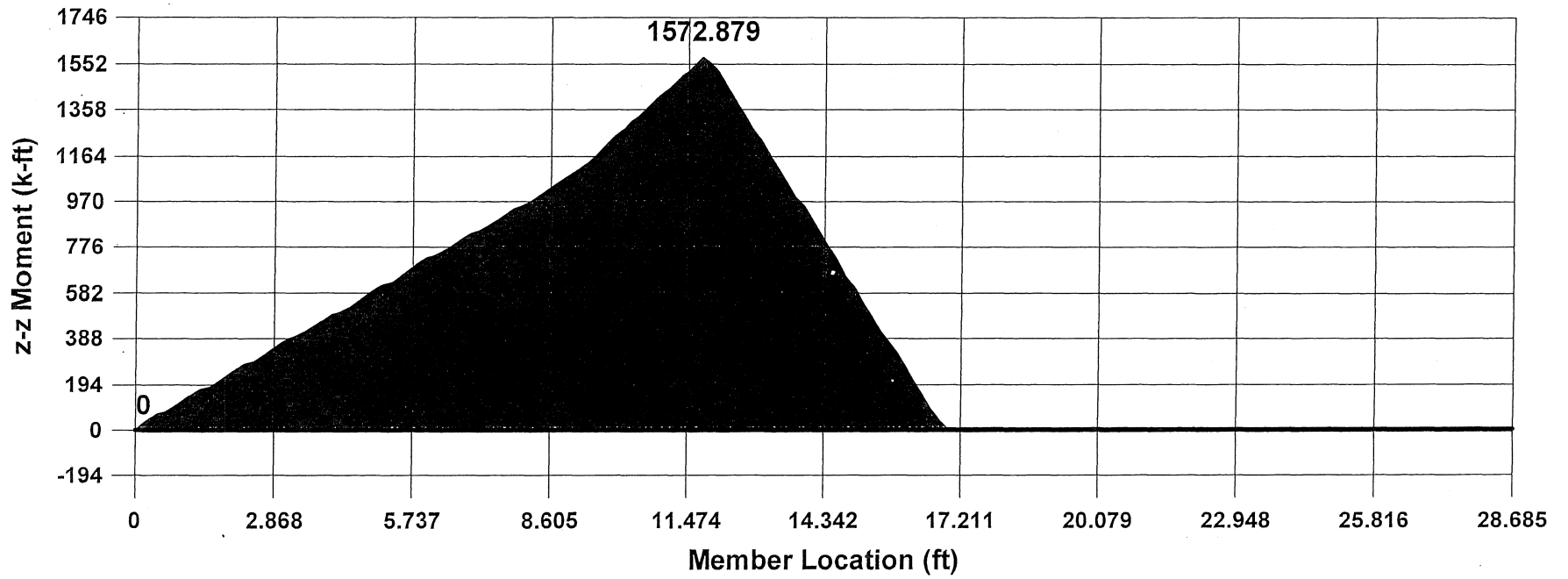
Code Check: **0.000 (bending)**

Report Based On 191 Sections



w/o Girder D

Member M1 , LC 6: One Lane L



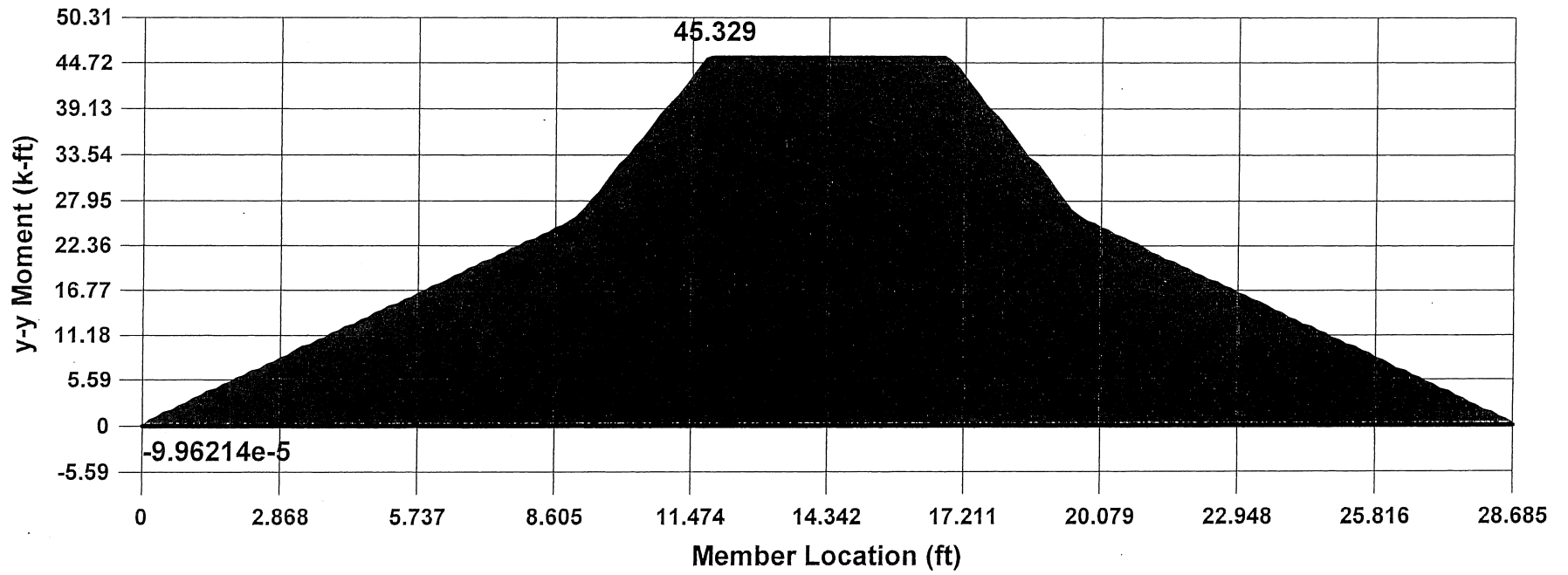
10.26' → Section -f → 1295.4 kip·ft. ✓

SCM
5/11/10

U-16

w/o Girder D

Member M1 , LC 6: One Lane L



ok
10.26' → section - f → 34.2 kip-ft.

USM
5/11/10

U-17

64801J-3A-P5
STRENGTH



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PROJECT MnDOT SS-69801J-3A-P5-Flexural Capacity
PROJECT # 090147 DATE 6/11/10 BY jdf SHEET NO. _____ OF _____
VCJM 6/24/10

New 6/11/10

The method used to determine the flexural capacity which follows may be conservative for sections with slender flanges. Flexural strength does not control design and therefore this conservativeness will not affect rating.

Refer to AISC LRFD steel code for a possible alternative method if one is required in future work.

Project: MnDOT Special Structures - 69801J - Bridge 3A Pier 5
 Date: 21-May-10
 RisaSection Name: BR3A-P5-c

Project Number: 90147
 Eng: JDF
 Checked By: *COM*

initial check 5/10/10
Recheck 6/24/10

Spreadsheet has been created for use with Box Steel Beam Caps Only.
 For sections with compact, non-compact, or slender flanges.
 For sections with compact or non-compact webs.

Yield Strengths:	F _{yc} :	36 ksi	F _{yt} :	36 ksi	F _{yw} :	36 ksi
Modulus of Elasticity:	E:	29000 ksi				
Compression Flange:	b _{fc} :	36 in	t _{fc} :	0.75 in		
Tension Flange:	b _{ft} :	36 in	t _{ft} :	0.75 in		
Webs:	D:	60.375 in	t _w :	0.5 in		
Clear Space between webs:		30 in				
Unbraced Length:	L _b :	125.1 in				
Neutral Axis:	Y-bar (Comp)	30.938 in	Y bar (Ten)	30.938 in	X-bar	18 in
Moment of Intertia:	I _{xx}	68780 in ⁴	I _{yy}	19870 in ⁴		
Section Modulus:	S _x (Comp)	2223.25 in ³	S _x (Ten)	2223.25 in ³	S _y	1104.12 in ³
Radius:	r _x	24.523 in	r _y	13.182 in		
Plastic Modulus:	Z _x	2561.66 in ³	Z _y	1406.72 in ³		
Torsional Constant:	J	15.071 in ⁴				

Based on AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition, 2007, With 2008 & 2009 Interim Revisions

Article 6.10 - I-Section Flexural Members

Article 6.10.6 - Strength Limit State

Article 6.10.6.2 - Flexure

Article 6.10.6.2.3 - Composite Sections in Negative Flexure and Noncomposite Sections

If the following conditions are met, proportion the section according to the provisions for compact or noncompact web sections specified in Appendix A. Otherwise, the section shall be proportioned according to provisions specified in Article 6.10.8.

Depth of Web in Comp:	D _c :	30.188 in
Moment of Inertia Comp Flange:	I _{yc} :	2916.0 in ⁴
Moment of Inertia Tens Flange:	I _{yt} :	2916.0 in ⁴

Yield Strength Limit:	Max F _y :	36 ksi	Limit F _y :	70 ksi	OK - Keep Going
Web Slenderness Limit (slender):	2*D _c /t _w :	120.752	5.7*(E/F _{yc}) ^{0.5} :	161.8 ksi	OK - Keep Going
Flange Ratio:	I _{yc} /I _{yt} :	1	Limit:	0.3	OK - Keep Going

Appendix A6: Flexural Resistance of Straight Composite I-Sections in Negative Flexure and Straight Non-composite I-sections with Compact or Noncompact Webs

Article A6.1 - General - Same as Article 6.10.6.2.3 above.

Article A6.1.1 - Sections with Discretely Braced Compression Flanges

At the limit state the following requirement shall be satisfied:

$$\mu + (1/3) * f_i * S_{xc} \leq \phi(f) * M_{nc}$$

Bending Moment - Major Axis:	M _u :	Varies, see Risa 3D
Flange Lateral Bending Stress:	f _i :	See Article 6.10.1.6

Flange lateral bending stress, f_i, may be determined directly from first-order elastic analysis in discretely braced compression flanges for which: $\lambda \leq 1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{0.5}$

Limiting Unbraced Length:	L _p :	See Article 6.10.8.2.3
	L _p :	1.0 * r _t * (E/F _{yc}) ^{0.5}
Effective Radius of Gyration:	r _t :	b _{fc} / (12 * (1 + (1/3) * (D _c * t _w / (b _{fc} * t _{fc})))) ^{0.5}
	r _t :	9.5 in
	L _p :	270.8 in

Moment Gradient Modifier:	C _b :	See Article 6.10.8.2.3 or Article A6.3.3, as applicable
	C _b :	1 Since M _{mid} /M ₂ > 1 at most situations. May be conservative at some locations.

Web Load-shedding Factor:	R _b :	See Article 6.10.1.10.2 1.0 if 2*D _c /t _w ≤ λ _{md} (rw)
Web Slenderness Limit (noncompact):	λ _{md} (rw):	5.7*(E/F _{yc}) ^{0.5} 161.8
	2*D _c /t _w :	120.752
	R _b :	1

Major Axis Bending to Yield Moment:	M _u /M _{yc} :	1 Assume 1.0. Conservative.
-------------------------------------	-----------------------------------	-----------------------------

Unbraced Limit for f _i :	L _b :	125.1 in	1.2 * L _p * (C _b * R _b / (M _u / M _{yc})) ^{0.5}	325.0 in	OK - Keep Going, First-order elastic analysis
-------------------------------------	------------------	----------	---	----------	---

Flange Lateral Bending Stress:	f _i :	M _u /S _y First-order elastic analysis
Factored Weak Axis Bending Moment:	M _{uy} :	See Risa

Resistance Factor for Flexure:	φ(f):	1 As specified in Article 6.5.4.2
--------------------------------	-------	-----------------------------------

Nominal Flexural Resistance:	M _{nc} :	See Article A6.3
------------------------------	-------------------	------------------

Nominal Flexural Resistance based on compression flange, M_{nc}, shall be taken as the smaller of the local buckling resistance determined as specified in Article A6.3.2, and the lateral torsional buckling resistance determined as specified in Article A6.3.3.

Article A6.3.2 - Local Buckling Resistance:

Determine if the compression flange is compact:

✓
6/24/10

Limiting Slenderness Ratio for Compact Flange:

Use two ratios, one for the flange between the webs, and the other for the flange overhang. See AISC Table B4.1.

Case 12: Uniform compression in flanges of rectangular box and hollow structural sections of uniform thickness subject to bending or compression.

lamda(f)	b/t:	40.00 <i>Clear space between webs/t/c</i>
lamda(pf)	$1.12 * (E/Fy)^{.5}$:	31.79
lamda(rf)	$1.40 * (E/Fy)^{.5}$:	39.74

Case 12: Slender Flange

Case 2: Flexure in flanges of doubly and singly symmetric I-shaped built-up sections.

lamda(f)	b/t:	3.67 <i>Flange overhang measured from mid-web/t/c</i>
lamda(pf)	$0.38 * (E/Fy)^{.5}$:	10.79
lamda(rf)	$0.95 * (E * k_c / Fy)^{.5}$:	19.44

k_c : $4 / (D/tw)^{.5}$: 0.36 but $0.35 \leq k_c \leq 0.76$

k_c : 0.36

Fy: smaller of 3 items below:

$0.7 * F_{yc}$: 25.2 ksi

$R_h * F_{yt} * S_{xt} / S_{xc}$: 36.0 ksi

Fyw: 36.0 ksi

but not less than:

$0.5 * F_{yc}$: 18.0 ksi

Fy: 25.2 ksi

Case 2: Compact Flange

If Case 2 Flange is Noncompact or Slender, then check lamdas used.

Slender Flange

Worse condition of Case 12 and Case 2

Compression Flange:

Nominal Flexural Resistance:

Mnc: $[1 - (1 - F_{yr} * S_{xc}) / (R_{pc} * M_{yc}) * (lamda(f) - lamda(pf)) / (lamda(rf) - lamda(pf))] * R_{pc} * M_{yc}$

Equation A6.3.2-1 or A6.3.2-2

Web Plastification Factor - Comp:

Rpc: See Article A6.2.1 or A6.2.2, as applicable

Article A6.2.1 - Compact Web Sections:

Determine if the web is compact:

Compact if $2 * D_{cp} / tw \leq lamda(pw(D_{cp}))$

Depth of Web in Comp at Plastic Mom:

Dcp: See Article D6.3.2

For non composite sections where: $F_{yw} * A_w \geq |F_{yc} * A_c - F_{yt} * A_t|$, $D_{cp} = D / (2 * A_w * F_{yw}) [F_{yt} * A_t + F_{yw} * A_w - F_{yc} * A_c]$, otherwise $D_{cp} = D$.

$F_{yw} * A_w$: 2173.5 kip

$|F_{yc} * A_c - F_{yt} * A_t|$: 0 kip

*Use $2 * D * tw$ for A_w due to two webs*

Dcp: 30.2 in

Limiting Slenderness Ratio for Compact Web:

lamda(pw(Dcp)): $((E/Fy)^{.5}) / (0.54 * (M_p / (R_h * M_y)) - 0.09)^{.2} \leq lamda(rw) * (D_{cp} / D_c)$

Plastic Moment

Mp: See Article D6.1

Article D6.1 - Plastic Moment:

Mp: See Table D6.1-2, Case I

$M_p / (2 * D) * [Y(\bar{b})^2 + (D - Y(\bar{b}))^2] + [P_{rt} * d_{rt} + P_{rb} * d_{rb} + P_t * d_t + P_c * d_c]$

$Y(\bar{b})$: $(D/2) * [(P_c - P_t - P_{rt} - P_{rb}) / P_w + 1]$

Pc: $F_{yc} * b_c * t_c$: 972 kip

Pt: $F_{yt} * b_t * t_t$: 972 kip

Prt: 0 no concrete reinforcing steel

Prb: 0 no concrete reinforcing steel

Pw: $F_{yw} * D * tw * 2$: 2173.5 kip

This is multiplied by 2 due to two webs

$Y(\bar{b})$: 30.1875

drt: 0 no concrete reinforcing steel

drt: 0 no concrete reinforcing steel

dt: $Y(\bar{b}) + t_{rt} / 2$: 30.5625 in

dc: $D - Y(\bar{b}) + t_{tc} / 2$: 30.5625 in

Mp: 92219.77 kip-in

Hybrid factor:

Rh: See Article 6.10.1.10.1

Rh: 1

Yield Moment

My: Smaller of Myc and Myt, See Article D6.2.

Myc: $F_{yc} * S_{xc}$: 80037 kip-in

Myt: $F_{yt} * S_{xt}$: 80037 kip-in

My: 80037 kip-in

lamda(pw(Dcp)): smaller of

$((E/Fy)^{.5}) / (0.54 * (M_p / (R_h * M_y)) - 0.09)^{.2}$: 100.2

lamda(rw) * (Dcp/Dc): 161.8

lamda(pw(Dcp)): 100.2

Web Compact?

$2 * D_{cp} / tw$: 120.8

lamda(pw(Dcp)): 100.2

Web is not compact, See Article A6.2.2

Web Plastification Factor - Comp:

Rpc: Mp/Myc

1.152

Article A6.2.2 - Noncompact Web Sections

Verify the webs are non-compact and not slender.

If $lamda(w) < lamda(rw)$, then noncompact.

Slenderness ratio for web:

lamda(w): $2 * D_c / tw$: 120.752

Limiting Slenderness ratio for noncompact web:

lamda(rw): $5.7 * (E/Fy)^{.5}$: 161.8

Noncompact vs Slender webs?

Noncompact, keep going

Web Plastification Factor - Comp:

Rpc: smaller of

$[1 - (1 - (R_h * M_{yc} / M_p)) * ((lamda(w) - lamda(pw(D_c))) / (lamda(rw) - lamda(pw(D_c))))] * (M_p / M_{yc})$

Mp/Myc

Limiting Slenderness ratio for a compact web:

V-3

VCSM
6/24/10

$\lambda(pw(Dc))$: smaller of $\lambda(pw(Dcp)) * (Dc/Dcp)$
 $\lambda(pw(Dcp)) * (Dc/Dcp)$ $\lambda(rw)$
 $\lambda(pw(Dc))$: 100.2
100.2

$[1 - (1 - (R_h * Myc / Mp)) * ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] * (Mp / Myc)$ 1.101
Mp/Myt 1.152

Rpc: 1.101 Use if Web is Noncompact

Web Plastification Factor Comp: Rpc (FINAL): 1.101

Nominal Flexural Resistance - comp: Mnc: 54955 kip-in Per Article A6.3.2

Article A6.3.3 - Lateral Torsional Buckling Resistance:

If $L_b \leq L_p$, then $Mnc = Rpc * Myc$
 $L_b \leq L_p$, therefore $Mnc = Rpc * Myc$ (Same as A6.3.2)
Mnc: 88155 kip-in Per Article A6.3.3

Nominal Flexural Resistance - Comp: Mnc: 54955 kip-in

A6.4 - Flexural Resistance Based on Tension Flange Yielding

Nominal Flexural Resistance - tension: Mnt: Rpt * Myt

Web Plastification Factor - Ten: Rpt: See Article A6.2.1 or Article A6.2.2 as applicable.

Article A6.2.1 - Compact Web Sections

Rpt: Mp/Myt 1.152

Article A6.2.2 - Noncompact Web Sections

Rpt: smaller of $[1 - (1 - (R_h * Myt / Mp)) * ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] * (Mp / Myt)$
Mp/Myt

$[1 - (1 - (R_h * Myt / Mp)) * ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] * (Mp / Myt)$ 1.101
Mp/Myt 1.152

Rpt: 1.101 Use if Web is Noncompact

Rpt (FINAL): 1.101

Nominal Flexural Resistance - Ten: Mnt: 88155 kip-in



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PROJECT MnDOT SS-69801J-P5-3A - Flexural Strength - AISC -1 ^{LRFD}
PROJECT # 090147 DATE 5/21/10 BY jdf ^{VCM} SHEET NO. OF
_{4/25/10}

Check flexural capacity of section - C by using AISC to verify using AISC Lambda's are OK
Chose section - C since - C controls design.

Follow AISC-13th Edition

F7. Square and Rectangular HSS and Box-Shaped Members.

Check F7.1, F7.2, & F7.3 (use smallest).

F7.1 Yielding

$$M_n = m_p = F_y Z \quad \checkmark$$

$$= 36 \text{ ksi} \times 2561.66 \text{ in}^3 = 92220 \text{ kip}\cdot\text{in} \quad \checkmark$$

F7.2 Flange Local Buckling.

Flange Slenderness: (Case 12)

$$\frac{b_f}{t} = \frac{30''}{.75'} = 40 \quad \checkmark$$

$$1.12 \sqrt{E/F_y} = 31.79 \quad \checkmark = \lambda_p$$

$$1.40 \sqrt{E/F_y} = 39.74 \quad \checkmark = \lambda_r$$

Since $\frac{b_f}{t} > \lambda_r$, flange is slender

Use Equation F7-3

$$M_n = F_y S_{eff}$$

$$b_e = 1.92 t \sqrt{E/F_y} \left[1 - \frac{0.38}{b/t} \sqrt{\frac{E}{F_y}} \right] \leq b. \quad \checkmark$$

$$= 1.92 \times .75 \sqrt{\frac{29000}{36}} \left[1 - \frac{0.38}{40} \sqrt{\frac{29000}{36}} \right] = 29.85'' \quad \checkmark$$

↑
controls.

(0.15" less than 30")



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PROJECT MnDOT SS-69801J-P5-3A- Flexural Strength - AISC LRFD - 2

PROJECT # 0901407 DATE 5/21/10 BY jdf SHEET NO. 1 OF 1

Self is based on flanges of
 $36 - 15 = 35.85"$

$$I_{xx} = 68780 \text{ in}^4 \checkmark$$

$$I_{xx \text{ eff}} = 68780 - 2 \times .75^3 \times 15 \div 12 - 2 \times .75 \times .15 \times (30.94 - \frac{.75}{2})^2$$

$$= 68780 - 0.01 - 210$$

$$= 68570 \text{ in}^4 \checkmark$$

$$y = 30.94" \checkmark$$

$$S_{xx \text{ eff}} = \frac{I}{y} = \frac{68570}{30.94} = 2216.2 \text{ in}^3 \checkmark$$

$$M_n = 36 \times 2216.2 = 79783 \text{ kip.in} \checkmark$$

F7.3 Web Local Buckling.

Web Slenderness: (Case 13)

$$\frac{h}{t} = \frac{60.375}{.5} = 120.75 \checkmark$$

$$2.42 \sqrt{E/F_y} = 68.7 \checkmark = \lambda_p$$

$$5.70 \sqrt{E/F_y} = 161.8 \checkmark = \lambda_r$$

Since $\lambda_p < \frac{h}{t} < \lambda_r$, web is noncompact
Use F7-5 $\checkmark$

$$M_n = M_p - (M_p - F_y S_x) \left(0.305 \frac{h}{t_w} \sqrt{\frac{F_y}{E}} - 0.738 \right) \leq M_p$$

$$= 92220 - (92220 - 36 \times 2223.25) (0.305 \times 120.75 \sqrt{\frac{36}{29000}} - 0.738)$$

$$= 92220 - (12183) (0.5596) = 85402 \text{ kip.in} \leq M_p \checkmark$$

$$M_n = 85402 \text{ kip.in.} \checkmark$$

Final $M_n = 79783 \text{ kip.in.}$

controlled by Flange Local Buckling



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PROJECT MnDOT SS-69801J-P5.3A-Flexural Strength-LRFD 6.12.

PROJECT # 090147 DATE 5/21/10 BY jdf SHEET NO. 6/25/10 OF 6/25/10

Check Flexural Capacity of section - C by using
AASHTO LRFD Section 6.12.2.2.2

$$M_n = F_y S \left[1 - \frac{0.064 F_y S l}{A E} \left(\frac{\sum \left(\frac{b}{t} \right)}{I_y} \right)^{0.5} \right] \checkmark$$

$$F_y = 36 \text{ ksi} \checkmark$$

$$S = 2223.25 \text{ in}^3 \checkmark$$

$$l = 125.1 \text{ in} \checkmark$$

$$A = 30.5 \times (60.375 + 75) = 1864.3 \text{ in}^2 \checkmark$$

$$E = 29000 \text{ ksi} \checkmark$$

$$\sum \left(\frac{b}{t} \right) = \left(\frac{30}{.75} \right) (2) + (60.375 \div .5) (2) = 321.5 \checkmark$$

$$I_y = 19870 \text{ in}^4 \checkmark$$

$$M_n = 36 \times 2223.25 \left[1 - \frac{0.064 \times 36 \times 2223.25 \times 125.1}{1864.3 \times 29000} \left(\frac{321.5}{19870} \right)^{0.5} \right] \checkmark$$
$$= 79916.3 \text{ kip} \cdot \text{in.} \checkmark$$

Project: MnDOT Special Structures - 69801J - Bridge 3A Pier 5
 Date: 21-May-10
 RisaSection Name: BR3A-P5-f

Project Number: 90147
 Eng: JDF
 Checked By: *CJM*

Spreadsheet has been created for use with Box Steel Beam Caps Only.
 For sections with compact, non-compact, or slender flanges.
 For sections with compact or non-compact webs.

initial check 5/10/10
recheck 6/24/10

Yield Strengths:	F _{yc} :	36 ksi	F _{yt} :	36 ksi	F _{yw} :	36 ksi
Modulus of Elasticity:	E:	29000 ksi				
Compression Flange:	b _{fc} :	36 in	t _{fc} :	0.75 in		
Tension Flange:	b _{ft} :	36 in	t _{ft} :	0.75 in		
Webs:	D:	65.688 in	t _w :	0.5 in		
Clear Space between webs:		30 in				
Unbraced Length:	L _b :	125.1 in				
Neutral Axis:	Y-bar (Comp)	33.594 in	Y bar (Ten)	33.594 in	X-bar	18 in
Moment of Inertia:	I _{xx} :	83210 in ⁴	I _{yy} :	21110 in ⁴		
Section Modulus:	S _x (Comp)	2476.95 in ³	S _x (Ten)	2476.95 in ³	S _y	1317 in ³
Radius:	r _x :	26.367 in	r _y :	13.281 in		
Plastic Modulus:	Z _x :	2872.53 in ³	Z _y :	1487.73 in ³		
Torsional Constant:	J:	15.514 in ⁴				

Based on AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition, 2007, With 2008 & 2009 Interim Revisions

Article 6.10 - I-Section Flexural Members

Article 6.10.6 - Strength Limit State

Article 6.10.6.2 - Flexure

Article 6.10.6.2.3 - Composite Sections in Negative Flexure and Noncomposite Sections

If the following conditions are met, proportion the section according to the provisions for compact or noncompact web sections specified in Appendix A. Otherwise, the section shall be proportioned according to provisions specified in Article 6.10.8.

Depth of Web in Comp:	D _c :	32.844 in
Moment of Inertia Comp Flange:	I _{yc} :	2916.0 in ⁴
Moment of Inertia Tens Flange:	I _{yt} :	2916.0 in ⁴

Yield Strength Limit:	Max F _y :	36 ksi	Limit F _y :	70 ksi	OK - Keep Going
Web Slenderness Limit (slender):	2*D _c /t _w :	131.376	5.7*(E/F _{yc}) ^{0.5} :	161.8 ksi	OK - Keep Going
Flange Ratio:	I _{yc} /I _{yt} :	1	Limit:	0.3	OK - Keep Going

Appendix A6: Flexural Resistance of Straight Composite I-Sections in Negative Flexure and Straight Non-composite I-sections with Compact or Noncompact Webs

Article A6.1 - General - Same as Article 6.10.6.2.3 above.

Article A6.1.1 - Sections with Discretely Braced Compression Flanges

At the limit state the following requirement shall be satisfied:

$$M_u + (1/3) * f_l * S_{xc} \leq \phi(f) * M_{nc}$$

Bending Moment - Major Axis:	M _u :	Varies, see Risa 3D
Flange Lateral Bending Stress:	f _l :	See Article 6.10.1.6

Flange lateral bending stress, f_l, may be determined directly from first-order elastic analysis in discretely braced compression flanges for which: $b \leq 1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{0.5}$

Limiting Unbraced Length:	L _p :	See Article 6.10.8.2.3
	L _p :	$1.0 * r_t * (E / F_{yc})^{0.5}$
Effective Radius of Gyration:	r _t :	$b_{fc} / (12 * (1 + (1/3) * (D_c * t_w / (b_{fc} * t_{fc}))))^{0.5}$
	r _t :	9.5 in
	L _p :	269.0 in

Moment Gradient Modifier:	C _b :	See Article 6.10.8.2.3 or Article A6.3.3, as applicable
	C _b :	1 Since M _{mid} /M ₂ > 1 at most situations. May be conservative at some locations.

Web Load-shedding Factor:	R _b :	See Article 6.10.1.10.2	1.0 if 2*D _c /t _w ≤ λ _{mda} (rw)
Web Slenderness Limit (noncompact):	λ _{mda} (rw):	5.7*(E/F _{yc}) ^{0.5}	161.8
	2*D _c /t _w :	131.376	
	R _b :	1	

Major Axis Bending to Yield Moment:	M _u /M _{yc} :	1 Assume 1.0. Conservative.
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Unbraced Limit for f _l :	L _b :	125.1 in	$1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{0.5}$	322.7 in	OK - Keep Going, First-order elastic analysis
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Flange Lateral Bending Stress:	f _l :	M _{uy} /S _y	First-order elastic analysis
Factored Weak Axis Bending Moment:	M _{uy} :	See Risa	

Resistance Factor for Flexure:	φ(f):	1 As specified in Article 6.5.4.2
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Nominal Flexural Resistance:	M _{nc} :	See Article A6.3
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Nominal Flexural Resistance based on compression flange, M_{nc}, shall be taken as the smaller of the local buckling resistance determined as specified in Article A6.3.2, and the lateral torsional buckling resistance determined as specified in Article A6.3.3.

Article A6.3.2 - Local Buckling Resistance:

Determine if the compression flange is compact:

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✓ 5/4
6/24/10

Limiting Slenderness Ratio for Compact Flange:

Use two ratios, one for the flange between the webs, and the other for the flange overhang. See AISC Table B4.1.

Case 12: Uniform compression in flanges of rectangular box and hollow structural sections of uniform thickness subject to bending or compression.

λ_{mf}	b/t	40.00 <i>Clear space between webs/t</i>
λ_{mpf}	$1.12 \cdot (E/F_y)^{0.5}$	31.79
λ_{mrf}	$1.40 \cdot (E/F_y)^{0.5}$	39.74

Case 12: Slender Flange

Case 2: Flexure in flanges of doubly and singly symmetric I-shaped built-up sections.

λ_{mf}	b/t	3.67 <i>Flange overhang measured from mid-web/t</i>
λ_{mpf}	$0.38 \cdot (E/F_y)^{0.5}$	10.79
λ_{mrf}	$0.95 \cdot (E \cdot k_c / F_y)^{0.5}$	19.07
k_c	$4 / (D/t_w)^{0.5}$	0.35 but $0.35 \leq k_c \leq 0.76$

k_c : 0.35

F_y : smaller of 3 items below:

$0.7 \cdot F_y$	25.2 ksi
$R_h \cdot F_y \cdot S_{xt} / S_{xc}$	36.0 ksi
F_y	36.0 ksi
but not less than:	
$0.5 \cdot F_y$	18.0 ksi

F_y : 25.2 ksi

Case 2: Compact Flange

If Case 2 Flange is Noncompact or Slender, then check λ used.

Slender Flange

Worse condition of Case 12 and Case 2

Compression Flange:

Nominal Flexural Resistance:

M_n : $[1 - (1 - (F_y \cdot S_{xc}) / (R_p \cdot M_y)) \cdot (\lambda_{mf} - \lambda_{mpf}) / (\lambda_{mrf} - \lambda_{mpf})] \cdot R_p \cdot M_y$

Equation A6.3.2-1 or A6.3.2-2

Web Plastification Factor - Comp:

R_p : See Article A6.2.1 or A6.2.2, as applicable

Article A6.2.1 - Compact Web Sections:

Determine if the web is compact:

Compact if $2 \cdot D_{cp} / t_w \leq \lambda_{mw}$ (pw(Dcp))

Depth of Web in Comp. at Plastic Mom:

D_{cp} : See Article D6.3.2

For non composite sections where: $F_y \cdot A_w \geq |F_y \cdot A_c - F_y \cdot A_t|$, $D_{cp} = D / (2 \cdot A_w \cdot F_y) [F_y \cdot A_t + F_y \cdot A_w - F_y \cdot A_c]$, otherwise $D_{cp} = D$.

$F_y \cdot A_w$: 2364.768 kip $|F_y \cdot A_c - F_y \cdot A_t|$: 0 kip

Use $2 \cdot D \cdot t_w$ for A_w due to two webs

D_{cp} : 32.8 in

Limiting Slenderness Ratio for Compact Web:

λ_{mw} (pw(Dcp)): $((E/F_y)^{0.5}) / (0.54 \cdot (M_p / (R_h \cdot M_y)) - 0.09)^{0.5} \leq \lambda_{mw} \cdot (D_{cp} / D_c)$

Plastic Moment

M_p : See Article D6.1

Article D6.1 - Plastic Moment:

M_p : See Table D6.1-2, Case 1

M_p : $P_w / (2 \cdot D) \cdot [Y(\bar{b})^2 + (D - Y(\bar{b}))^2] + [P_{rt} \cdot d_{rt} + P_{rb} \cdot d_{rb} + P_t \cdot d_t + P_c \cdot d_c]$

$Y(\bar{b})$: $(D/2) \cdot [(P_c - P_t - P_{rt} - P_{rb}) / P_w + 1]$

P_c : $F_y \cdot b_c \cdot t_c$: 972 kip

P_t : $F_y \cdot b_t \cdot t_t$: 972 kip

P_{rt} : 0 no concrete reinforcing steel

P_{rb} : 0 no concrete reinforcing steel

P_w : $F_y \cdot D \cdot t_w \cdot 2$: 2364.768 kip

This is multiplied by 2 due to two webs

$Y(\bar{b})$: 32.844

d_{rt} : 0 no concrete reinforcing steel

d_{rb} : 0 no concrete reinforcing steel

d_t : $Y(\bar{b}) + t_t / 2$: 33.219 in

d_c : $D - Y(\bar{b}) + t_c / 2$: 33.219 in

M_p : 103412 kip-in

Hybrid factor:

R_h : See Article 6.10.1.10.1

R_h : 1

Yield Moment

M_y : Smaller of M_{yc} and M_{yt} , See Article D6.2.

M_{yc} : $F_y \cdot S_{xc}$: 89170 kip-in

M_{yt} : $F_y \cdot S_{xt}$: 89170 kip-in

M_y : 89170.2 kip-in

λ_{mw} (pw(Dcp)): smaller of

$((E/F_y)^{0.5}) / (0.54 \cdot (M_p / (R_h \cdot M_y)) - 0.09)^{0.5}$: 98.7

$\lambda_{mw} \cdot (D_{cp} / D_c)$: 161.8

λ_{mw} (pw(Dcp)): 98.7

Web Compact?

$2 \cdot D_{cp} / t_w$: 131.4

λ_{mw} (pw(Dcp)): 98.7

Web is not compact, See Article A6.2.2

Web Plastification Factor - Comp:

R_p : M_p / M_y

1.160

Article A6.2.2 - Noncompact Web Sections

Verify the webs are non-compact and not slender.

If $\lambda_{mw} < \lambda_{mw}$, then noncompact.

Slenderness ratio for web:

λ_{mw} : $2 \cdot D_{cp} / t_w$: 131.376

Limiting Slenderness ratio for noncompact web:

λ_{mw} : $5.7 \cdot (E/F_y)^{0.5}$: 161.8

Noncompact vs Slender webs?

Noncompact, keep going

Web Plastification Factor - Comp:

R_p : smaller of

$[1 - (R_h \cdot M_y / M_p)] \cdot ((\lambda_{mw} - \lambda_{mw}) / (\lambda_{mw} - \lambda_{mw})) \cdot (M_p / M_y)$

Limiting Slenderness ratio for a compact web:

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lamda(pw(Dc)): smaller of lamda(pw(Dcp))*(Dc/Dcp)
lamda(rw)
lamda(pw(Dcp))*(Dc/Dcp) 98.7
lamda(pw(Dc)): 98.7
$$\frac{[1-(1-(Rh*Myc/Mp))*((lamda(w)-lamda(pw(Dc)))/(lamda(rw)-lamda(pw(Dc))))*(Mp/Myc)]}{Mp/Myc}$$
 1.077
1.160

Rpc: 1.077 Use if Web is Noncompact

Web Plastification Factor Comp: Rpc (FINAL): 1.077

Nominal Flexural Resistance - comp: Mnc: 61299 kip-in Per Article A6.3.2

Article A6.3.3 - Lateral Torsional Buckling Resistance:

If $L_b \leq L_p$, then $M_{nc} = R_{pc} * M_{yc}$
 $L_b \leq L_p$, therefore $M_{nc} = R_{pc} * M_{yc}$ (Same as A6.3.2)
Mnc: 96035 kip-in Per Article A6.3.3

Nominal Flexural Resistance - Comp: Mnc: 61299 kip-in

A6.4 - Flexural Resistance Based on Tension Flange Yielding

Nominal Flexural Resistance - tension: Mnt: Rpt*Myt
Web Plastification Factor - Ten: Rpt: See Article A6.2.1 or Article A6.2.2 as applicable.

Article A6.2.1 - Compact Web Sections
Rpt: Mp/Myt: 1.160

Article A6.2.2 - Noncompact Web Sections
Rpt: smaller of $\frac{[1-(1-(Rh*Myt/Mp))*((lamda(w)-lamda(pw(Dc)))/(lamda(rw)-lamda(pw(Dc))))*(Mp/Myt)]}{Mp/Myt}$ 1.077
1.160
Rpt: 1.077 Use if Web is Noncompact

Rpt (FINAL): 1.077

Nominal Flexural Resistance - Ten: Mnt: 96035 kip-in

Project: MnDOT Special Structures - 69801J - Bridge 3A Pier 5
 Date: 21-May-10
 RisaSection Name: BR3A-P5-g

Project Number: 90147
 Eng: JDF
 Checked By: com

initial check 5/10/10
 recheck 6/24/10

Spreadsheet has been created for use with Box Steel Beam Caps Only.
 For sections with compact, non-compact, or slender flanges.
 For sections with compact or non-compact webs.

Yield Strengths:	F _{yc} :	36 ksi	F _{yt} :	36 ksi	F _{yw} :	36 ksi
Modulus of Elasticity:	E:	29000 ksi				
Compression Flange:	b _{fc} :	36 in	t _{fc} :	1.5 in		
Tension Flange:	b _{tc} :	36 in	t _{tc} :	0.75 in		
Webs:	D:	64.313 in	t _w :	0.5 in		
Clear Space between webs:		30 in				
Unbraced Length:	L _b :	125.1 in				
Neutral Axis:	Y-bar (Comp)	27.478 in	Y bar (Ten)	39.085 in	X-bar	18 in
Moment of Inertia:	I _{xx}	103700 in ⁴	I _{yy}	23710 in ⁴		
Section Modulus:	S _x (Comp)	3773.13 in ³	S _x (Ten)	2652.65 in ³	S _y	1317 in ³
Radius:	r _x	26.711 in	r _y	12.773 in		
Plastic Modulus:	Z _x	3507.41 in ³	Z _y	1709.77 in ³		
Torsional Constant:	J	50.4 in ⁴				

Based on AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition, 2007, With 2008 & 2009 Interim Revisions

Article 6.10 - I-Section Flexural Members

Article 6.10.6 - Strength Limit State

Article 6.10.6.2 - Flexure

Article 6.10.6.2.3 - Composite Sections in Negative Flexure and Noncomposite Sections

If the following conditions are met, proportion the section according to the provisions for compact or noncompact web sections specified in Appendix A. Otherwise, the section shall be proportioned according to provisions specified in Article 6.10.8.

Depth of Web in Comp:	D _c :	25.978 in
Moment of Inertia Comp Flange:	I _{yc} :	5832.0 in ⁴
Moment of Inertia Tens Flange:	I _{yt} :	2916.0 in ⁴

Yield Strength Limit:	Max F _y :	36 ksi	Limit F _y :	70 ksi	OK - Keep Going
Web Slenderness Limit (slender):	2*D _c /t _w :	103.912	5.7*(E/F _{yc}) ^{0.5} :	161.8 ksi	OK - Keep Going
Flange Ratio:	I _{yc} /I _{yt} :	2	Limit:	0.3	OK - Keep Going

Appendix A6: Flexural Resistance of Straight Composite I-Sections in Negative Flexure and Straight Non-composite I-sections with Compact or Noncompact Webs

Article A6.1 - General - Same as Article 6.10.6.2.3 above.

Article A6.1.1 - Sections with Discretely Braced Compression Flanges

At the limit state the following requirement shall be satisfied:

$$M_u + (1/3) * f_l * S_{xc} \leq \phi(f) * M_{nc}$$

Bending Moment - Major Axis:	M _u :	Varies, see Risa 3D
Flange Lateral Bending Stress:	f _l :	See Article 6.10.1.6

Flange lateral bending stress, f_l, may be determined directly from first-order elastic analysis in discretely braced compression flanges for which: $b \leq 1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{0.5}$

Limiting Unbraced Length:	L _p :	See Article 6.10.8.2.3
	L _p :	$1.0 * r_t * (E / F_{yc})^{0.5}$
Effective Radius of Gyration:	r _t :	$b_{fc} / (12 * (1 + (1/3) * (D_c * t_w / (b_{tc} * t_{fc}))))^{0.5}$
	r _t :	10.0 in
	L _p :	283.8 in

Moment Gradient Modifier:	C _b :	See Article 6.10.8.2.3 or Article A6.3.3, as applicable
	C _b :	1 Since M _{mid} /M ₂ > 1 at most situations. May be conservative at some locations.

Web Load-shedding Factor:	R _b :	See Article 6.10.1.10.2	1.0 if 2*D _c /t _w ≤ λ _{rw}
Web Slenderness Limit (noncompact):	λ _{rw} :	$5.7 * (E / F_{yc})^{0.5}$	161.8
	2*D _c /t _w :	103.912	
	R _b :	1	

Major Axis Bending to Yield Moment:	M _u /M _{yc} :	1 Assume 1.0. Conservative.
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Unbraced Limit for f _l :	L _b :	125.1 in	$1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{0.5}$	340.6 in	OK - Keep Going, First-order elastic analysis
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Flange Lateral Bending Stress:	f _l :	M _u /S _y	First-order elastic analysis
Factored Weak Axis Bending Moment:	M _{uy} :	See Risa	

Resistance Factor for Flexure:	φ(f):	1 As specified in Article 6.5.4.2
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Nominal Flexural Resistance: M_{nc}: See Article A6.3

Nominal Flexural Resistance based on compression flange, M_{nc}, shall be taken as the smaller of the local buckling resistance determined as specified in Article A6.3.2, and the lateral torsional buckling resistance determined as specified in Article A6.3.3.

Article A6.3.2 - Local Buckling Resistance:

Determine if the compression flange is compact:

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Limiting Slenderness Ratio for Compact Flange:

Use two ratios, one for the flange between the webs, and the other for the flange overhang. See AISC Table B4.1.

Case 12: Uniform compression in flanges of rectangular box and hollow structural sections of uniform thickness subject to bending or compression.

λ_{mf}	b/t	20.00 <i>Clear space between webs/t_{fc}</i>
λ_{mpf}	$1.12 \cdot (E/F_y)^{0.5}$	31.79
λ_{mrf}	$1.40 \cdot (E/F_y)^{0.5}$	39.74

Case 12: Compact Flange

Case 2: Flexure in flanges of doubly and singly symmetric I-shaped built-up sections.

λ_{mf}	b/t	1.83 <i>Flange overhang measured from mid-web/t_{fc}</i>
λ_{mpf}	$0.38 \cdot (E/F_y)^{0.5}$	10.79
λ_{mrf}	$0.95 \cdot (E \cdot k_c / F_y)^{0.5}$	19.14
k_c	$4 / (D/t_w)^{0.5}$	0.35 but $0.35 \leq k_c \leq 0.76$
k_c	0.35	

F_y: smaller of 3 items below:

$0.7 \cdot F_{yc}$	25.2 ksi
$R_h \cdot F_{yt} \cdot S_{xt} / S_{xc}$	25.3 ksi
F _{yw}	36.0 ksi
but not less than:	
$0.5 \cdot F_{yc}$	18.0 ksi

F_y: 25.2 ksi

Case 2: Compact Flange

If Case 2 Flange is Noncompact or Slender, then check λ values used.

Compact Flange *Worse condition of Case 12 and Case 2*

Compression Flange:

Nominal Flexural Resistance:

M_{nc}: M_{nc} = R_{pc} · M_{yc}

Equation A6.3.2-1 or A6.3.2-2

Web Plastification Factor - Comp:

R_{pc}: See Article A6.2.1 or A6.2.2, as applicable

Article A6.2.1 - Compact Web Sections:

Determine if the web is compact:

Compact if $2 \cdot D_{cp} / t_w \leq \lambda_{mf}$ (pw(D_{cp}))

Depth of Web in Comp at Plastic Mom:

D_{cp}: See Article D6.3.2

For non composite sections where: $F_{yw} \cdot A_w \geq [F_{yc} \cdot A_c - F_{yt} \cdot A_t]$, $D_{cp} = D / (2 \cdot A_w \cdot F_{yw}) [F_{yt} \cdot A_t + F_{yw} \cdot A_w - F_{yc} \cdot A_c]$, otherwise $D_{cp} = D$.

F_{yw} · A_w: 2315.268 kip | F_{yc} · A_c - F_{yt} · A_t: 972 kip

Use $2 \cdot D \cdot t_w$ for A_w due to two webs

D_{cp}: 18.7 in

Limiting Slenderness Ratio for Compact Web:

λ_{mf} (pw(D_{cp})): $((E/F_y)^{0.5}) / (0.54 \cdot (M_p / (R_h \cdot M_y)) - 0.09)^{0.5} \leq \lambda_{mf} (rw) \cdot (D_{cp} / D_c)$

Plastic Moment

M_p: See Article D6.1

Article D6.1 - Plastic Moment:

M_p: See Table D6.1-2, Case I

M_p: $P_w / (2 \cdot D) \cdot [Y(\bar{y})^2 + (D - Y(\bar{y}))^2] + [P_{rt} \cdot d_{rt} + P_{rb} \cdot d_{rb} + P_t \cdot d_t + P_c \cdot d_c]$

Y($\bar{y}$): $(D/2) \cdot [(P_c - P_t - P_{rt} - P_{rb}) / P_w + 1]$

P_c: F_{yc} · b_c · t_c: 1944 kip

P_t: F_{yt} · b_t · t_t: 972 kip

P_{rt}: 0 no concrete reinforcing steel

P_{rb}: 0 no concrete reinforcing steel

P_w: F_{yw} · D · t_w · 2: 2315.268 kip

This is multiplied by 2 due to two webs

Y($\bar{y}$): 45.6565

d_{rt}: 0 no concrete reinforcing steel

d_{rb}: 0 no concrete reinforcing steel

d_t: Y($\bar{y}$) + t_t / 2: 46.0315 in

d_c: D - Y($\bar{y}$) + t_c / 2: 19.4065 in

M_p: 126255.3 kip-in

Hybrid factor:

R_h: See Article 6.10.1.10.1

R_h: 1

Yield Moment

M_y: Smaller of M_{yc} and M_{yt}, See Article D6.2.

M_{yc}: F_{yc} · S_{xc}: 135833 kip-in

M_{yt}: F_{yt} · S_{xt}: 95495 kip-in

M_y: 95495.4 kip-in

λ_{mf} (pw(D_{cp})): smaller of

$((E/F_y)^{0.5}) / (0.54 \cdot (M_p / (R_h \cdot M_y)) - 0.09)^{0.5}$: 72.9

$\lambda_{mf} (rw) \cdot (D_{cp} / D_c)$: 116.2

λ_{mf} (pw(D_{cp})): 72.9

Web Compact?

$2 \cdot D_{cp} / t_w$: 74.6

λ_{mf} (pw(D_{cp})): 72.9

Web is not compact, See Article A6.2.2

Web Plastification Factor - Comp: R_{pc}: M_p / M_{yc}: 0.929 *1.0 for 100% Compact*

Article A6.2.2 - Noncompact Web Sections

Verify the webs are non-compact and not slender.

If $\lambda_{mf} (w) < \lambda_{mf} (rw)$, then noncompact.

Slenderness ratio for web:

$\lambda_{mf} (w)$: $2 \cdot D_{cp} / t_w$: 103.912

Limiting Slenderness ratio for noncompact web:

$\lambda_{mf} (rw)$: $5.7 \cdot (E/F_y)^{0.5}$: 161.8

Noncompact vs Slender webs?

Noncompact, keep going

Web Plastification Factor - Comp:

R_{pc}: smaller of $[1 - (1 - R_h \cdot M_{yc} / M_p)] \cdot ((\lambda_{mf} (w) - \lambda_{mf} (pw(D_c))) / (\lambda_{mf} (rw) - \lambda_{mf} (pw(D_c)))) \cdot (M_p / M_{yc})$

Limiting Slenderness ratio for a compact web:

V-12

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6/24/10

lamda(pw(Dc)): smaller of lamda(pw(Dcp))*(Dc/Dcp)
lamda(rw)
lamda(pw(Dcp))*(Dc/Dcp) 101.5
lamda(pw(Dc)): 101.5

$[1 - (1 - (R_h * Myc / Mp)) * ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] * (Mp / Myc)$ 0.932
Mp/Myc 0.929

Rpc: 0.929 Use if Web is Noncompact

Web Plastification Factor Comp: Rpc (FINAL): 0.929

Nominal Flexural Resistance - comp: Mnc: 126255 kip-in Per Article A6.3.2

Article A6.3.3 - Lateral Torsional Buckling Resistance:

If $L_b \leq L_p$, then $M_{nc} = R_{pc} * Myc$
 $L_b \leq L_p$, therefore $M_{nc} = R_{pc} * Myc$ (Same as A6.3.2)
Mnc: 126255 kip-in Per Article A6.3.3

Nominal Flexural Resistance - Comp: Mnc: 126255 kip-in

A6.4 - Flexural Resistance Based on Tension Flange Yielding

Nominal Flexural Resistance - tension: Mnt: Rpt * Myt
Web Plastification Factor - Ten: Rpt: See Article A6.2.1 or Article A6.2.2 as applicable.

Article A6.2.1 - Compact Web Sections

Rpt: Mp/Myt 1.322 Use if Web is Compact

Article A6.2.2 - Noncompact Web Sections

Rpt: smaller of $[1 - (1 - (R_h * Myt / Mp)) * ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] * (Mp / Myt)$
Mp/Myt

$[1 - (1 - (R_h * Myt / Mp)) * ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] * (Mp / Myt)$ 1.309
Mp/Myt 1.322

Rpt: 1.309 Use if Web is Noncompact

Rpt (FINAL): 1.309

Nominal Flexural Resistance - Ten: Mnt: 125033 kip-in

Project: MnDOT Special Structures - 69801J - Bridge 3A Pier 5
 Date: 4-Feb-10
 RisaSection Name: BR3A-P5-c

Project Number: 90147
 Eng: JDF
 Checked By:

5/21/10

Spreadsheet has been created for use with Box Steel Beam Caps Only.
 For sections with compact, non-compact, or slender flanges.
 For sections with compact or non-compact webs.

Yield Strengths:	F _{yc} :	36 ksi	F _{yt} :	36 ksi	F _{yw} :	36 ksi
Modulus of Elasticity:	E:	29000 ksi				
Compression Flange:	b _{fc} :	36 in	t _{fc} :	0.75 in		
Tension Flange:	b _{tc} :	36 in	t _{tc} :	0.75 in		
Webs:	D:	60.375 in	tw:	0.5 in		
Clear Space between webs:		30 in				
Unbraced Length:	L _b :	125.1 in				
Neutral Axis:	Y-bar (Comp)	30.938 in	Y bar (Ten)	30.938 in	X-bar	18 in
Moment of Inertia:	I _{xx}	68780 in ⁴	I _{yy}	19870 in ⁴		
Section Modulus:	S _x (Comp)	2223.25 in ³	S _x (Ten)	2223.25 in ³	S _y	1104.12 in ³
Radius:	r _x	24.523 in	r _y	13.182 in		
Plastic Modulus:	Z _x	2561.66 in ³	Z _y	1406.72 in ³		
Torsional Constant:	J	15.071 in ⁴				

Based on AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition, 2007, With 2008 & 2009 Interim Revisions

Article 6.10 - I-Section Flexural Members

Article 6.10.6 - Strength Limit State

Article 6.10.6.2 - Flexure

Article 6.10.6.2.3 - Composite Sections in Negative Flexure and Noncomposite Sections

If the following conditions are met, proportion the section according to the provisions for compact or noncompact web sections specified in Appendix A. Otherwise, the section shall be proportioned according to provisions specified in Article 6.10.8.

Depth of Web in Comp:	D _c :	30.188 in
Moment of Inertia Comp Flange:	I _{yc} :	2916.0 in ⁴
Moment of Inertia Tens Flange:	I _{yt} :	2916.0 in ⁴

Yield Strength Limit:	Max F _y :	36 ksi	Limit F _y :	70 ksi	OK - Keep Going
Web Slenderness Limit (slender):	2*D _c /tw:	120.752	5.7*(E/F _{yc}) ^{0.5} :	161.8 ksi	OK - Keep Going
Flange Ratio:	I _{yc} /I _{yt} :	1	Limit:	0.3	OK - Keep Going

Appendix A6: Flexural Resistance of Straight Composite I-Sections in Negative Flexure and Straight Non-composite I-sections with Compact or Noncompact Webs

Article A6.1 - General - Same as Article 6.10.6.2.3 above.

Article A6.1.1 - Sections with Discretely Braced Compression Flanges

At the limit state the following requirement shall be satisfied: $M_u + (1/3) * f_l * S_{xc} \leq \phi(f) * M_{nc}$

Bending Moment - Major Axis:	M _u :	Varies, see Risa 3D
Flange Lateral Bending Stress:	f _l :	See Article 6.10.1.6

Flange lateral bending stress, f_l, may be determined directly from first-order elastic analysis in discretely braced compression flanges for which: $L_b \leq 1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{0.5}$

Limiting Unbraced Length:	L _p :	See Article 6.10.8.2.3
	L _p :	1.0 * r _x * (E/F _{yc}) ^{0.5}
Effective Radius of Gyration:	r _x :	$b_{fc} / (12 * (1 + (1/3) * (D_c * tw / (b_{fc} * t_{fc}))))^{0.5}$
	r _x :	9.5 in
	L _p :	270.8 in

Moment Gradient Modifier:	C _b :	See Article 6.10.8.2.3 or Article A6.3.3, as applicable
	C _b :	1 Since M _{mid} /M ₂ > 1 at most situations. May be conservative at some locations.

Web Load-shedding Factor:	R _b :	See Article 6.10.1.10.2 1.0 if 2*D _c /tw ≤ λ _{md} (rw)
Web Slenderness Limit (noncompact):	λ _{md} (rw):	5.7*(E/F _{yc}) ^{0.5} 161.8
	2*D _c /tw:	120.752
	R _b :	1

Major Axis Bending to Yield Moment:	M _u /M _{yc} :	1 Assume 1.0. Conservative.
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Unbraced Limit for f _l :	L _b :	125.1 in	1.2 * L _p * (C _b * R _b / (M _u / M _{yc})) ^{0.5}	325.0 in	OK - Keep Going, First-order elastic analysis
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Flange Lateral Bending Stress:	f _l :	M _{uy} /S _y First-order elastic analysis
Factored Weak Axis Bending Moment:	M _{uy} :	See Risa

Resistance Factor for Flexure:	φ(f):	1 As specified in Article 6.5.4.2
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Nominal Flexural Resistance:	M _{nc} :	See Article A6.3
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Nominal Flexural Resistance based on compression flange, M_{nc}, shall be taken as the smaller of the local buckling resistance determined as specified in Article A6.3.2, and the lateral torsional buckling resistance determined as specified in Article A6.3.3.

Article A6.3.2 - Local Buckling Resistance:

Determine if the compression flange is compact:

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Limiting Slenderness Ratio for Compact Flange:

Use two ratios, one for the flange between the webs, and the other for the flange overhang. See AISC Table B4.1.

Case 12: Uniform compression in flanges of rectangular box and hollow structural sections of uniform thickness subject to bending or compression.

λ_{mf}	b/t	40.00 <i>Clear space between webs/t</i>
λ_{mpf}	$1.12 \cdot (E/F_y)^{0.5}$	31.79
λ_{mrf}	$1.40 \cdot (E/F_y)^{0.5}$	39.74

Case 12: Slender Flange

Case 2: Flexure in flanges of doubly and singly symmetric I-shaped built-up sections.

λ_{mf}	b/t	3.67 <i>Flange overhang measured from mid-web/t</i>
λ_{mpf}	$0.38 \cdot (E/F_y)^{0.5}$	10.79
λ_{mrf}	$0.95 \cdot (E \cdot k_c / F_y)^{0.5}$	19.44
k_c	$4 / (D/t_w)^{0.5}$	0.36 but $0.35 \leq k_c \leq 0.76$

k_c : 0.36

F_y: smaller of 3 items below:

$0.7 \cdot F_{yc}$	25.2 ksi
$R_h \cdot F_{yt} \cdot S_{xt} / S_{xc}$	36.0 ksi
F _{yw}	36.0 ksi
but not less than:	
$0.5 \cdot F_{yc}$	18.0 ksi

F_y: 25.2 ksi

Case 2: Compact Flange *If Case 2 Flange is Noncompact or Slender, then check λ mdas used.*

Compression Flange: Slender Flange *Worse condition of Case 12 and Case 2*

Nominal Flexural Resistance: M_{nc}: $[1 - (1 - F_{yr} \cdot S_{xc}) / (R_{pc} \cdot M_{yc}) \cdot (\lambda_{mf} - \lambda_{mpf}) / (\lambda_{mrf} - \lambda_{mpf})] \cdot R_{pc} \cdot M_{yc}$ *Equation A6.3.2-1 or A6.3.2-2*
Web Plastification Factor - Comp: R_{pc}: See Article A6.2.1 or A6.2.2, as applicable

Article A6.2.1 - Compact Web Sections:

Determine if the web is compact:

Compact if $2 \cdot D_{cp} / t_w \leq \lambda_{md}$ (pw(D_{cp}))

Depth of Web in Comp at Plastic Mom: D_{cp}: See Article D6.3.2

For non composite sections where: $F_{yw} \cdot A_w \geq [F_{yc} \cdot A_c - F_{yt} \cdot A_t]$, $D_{cp} = D / (2 \cdot A_w \cdot F_{yw}) [F_{yt} \cdot A_t + F_{yw} \cdot A_w - F_{yc} \cdot A_c]$, otherwise $D_{cp} = D$.

F_{yw} · A_w: 2173.5 kip | F_{yc} · A_c - F_{yt} · A_t: 0 kip *Use $2 \cdot D \cdot t_w$ for A_w due to two webs*

D_{cp}: 30.2 in

Limiting Slenderness Ratio for Compact Web:

λ_{md} (pw(D_{cp})): $((E/F_y)^{0.5}) / (0.54 \cdot (M_p / (R_h \cdot M_y)) - 0.09)^{0.2} \leq \lambda_{md}(rw) \cdot (D_{cp} / D_c)$

Plastic Moment Mp: See Article D6.1

Article D6.1 - Plastic Moment:

M_p: See Table D6.1-2, Case I

M_p: $P_w / (2 \cdot D) \cdot [Y(\bar{b})^2 + (D - Y(\bar{b}))^2] + [P_{rt} \cdot d_{rt} + P_{rb} \cdot d_{rb} + P_t \cdot d_t + P_c \cdot d_c]$

Y($\bar{b}$): $(D/2) \cdot [(P_c - P_t - P_{rt} - P_{rb}) / P_w + 1]$

P_c: F_{yc} · b_c · t_c: 972 kip

P_t: F_{yt} · b_t · t_t: 972 kip

P_{rt}: 0 *no concrete reinforcing steel*

P_{rb}: 0 *no concrete reinforcing steel*

P_w: F_{yw} · D · t_w · 2: 2173.5 kip *This is multiplied by 2 due to two webs*

Y($\bar{b}$): 30.1875

d_{rt}: 0 *no concrete reinforcing steel*

d_{rb}: 0 *no concrete reinforcing steel*

d_t: Y($\bar{b}$) + t_r / 2: 30.5625 in

d_c: D - Y($\bar{b}$) + t_r / 2: 30.5625 in

M_p: 92219.77 kip-in

Hybrid factor:

R_h: See Article 6.10.1.10.1

R_h: 1

Yield Moment

M_y: Smaller of M_{yc} and M_{yt}, See Article D6.2.

M_{yc}: F_{yc} · S_{xc}: 80037 kip-in

M_{yt}: F_{yt} · S_{xt}: 80037 kip-in

M_y: 80037 kip-in

λ_{md} (pw(D_{cp})): smaller of

$((E/F_y)^{0.5}) / (0.54 \cdot (M_p / (R_h \cdot M_y)) - 0.09)^{0.2}$ 100.2

$\lambda_{md}(rw) \cdot (D_{cp} / D_c)$ 161.8

λ_{md} (pw(D_{cp})): 100.2

Web Compact?

$2 \cdot D_{cp} / t_w$: 120.8

λ_{md} (pw(D_{cp})): 100.2

Web is not compact, See Article A6.2.2

Web Plastification Factor - Comp: R_{pc}: M_p / M_{yc}: 1.152 *See AISC Table B4.1*

Article A6.2.2 - Noncompact Web Sections

Verify the webs are non-compact and not slender.

If $\lambda_{md}(w) < \lambda_{md}(rw)$, then noncompact.

Slenderness ratio for web: $\lambda_{md}(w)$: $2 \cdot D_c / t_w$: 120.752

Limiting Slenderness ratio for noncompact web: $\lambda_{md}(rw)$: $5.7 \cdot (E/F_y)^{0.5}$: 161.8

Noncompact vs Slender webs?

Noncompact, keep going

Web Plastification Factor - Comp: R_{pc}: smaller of $[1 - (1 - R_h \cdot M_{yc} / M_p) \cdot ((\lambda_{md}(w) - \lambda_{md}(pw(D_c))) / (\lambda_{md}(rw) - \lambda_{md}(pw(D_c))))] \cdot (M_p / M_{yc})$

Limiting Slenderness ratio for a compact web:

$\lambda(pw(Dc))$: smaller of $\lambda(pw(Dcp)) * (Dc/Dcp)$
 $\lambda(pw(Dcp)) * (Dc/Dcp)$ $\lambda(rw)$
 $\lambda(pw(Dc))$: 100.2
100.2

$[1 - (1 - (R_h * Myc / Mp)) * ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] * (Mp / Myc)$ 1.101
 Mp / Myc 1.152

R_{pc} : 1.101 *Use if Web is Noncompact*

Web Plastification Factor - Comp: R_{pc} (FINAL): 1.101

Nominal Flexural Resistance - comp: M_{nc} : 54955 kip-in Per Article A6.3.2

Article A6.3.3 - Lateral Torsional Buckling Resistance:

If $L_b \leq L_p$, then $M_{nc} = R_{pc} * Myc$
 $L_b \leq L_p$, therefore $M_{nc} = R_{pc} * Myc$ (Same as A6.3.2)
 M_{nc} : 88155 kip-in Per Article A6.3.3

Nominal Flexural Resistance - Comp: M_{nc} : 54955 kip-in

A6.4 - Flexural Resistance Based on Tension Flange Yielding

Nominal Flexural Resistance - tension: M_{nt} : $R_{pt} * Myt$

Web Plastification Factor - Ten: R_{pt} : See Article A6.2.1 or Article A6.2.2 as applicable.

Article A6.2.1 - Compact Web Sections

R_{pt} : Mp / Myt 1.152 *Use if Web is Noncompact*

Article A6.2.2 - Noncompact Web Sections

R_{pt} : smaller of $[1 - (1 - (R_h * Myt / Mp)) * ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] * (Mp / Myt)$
 Mp / Myt

$[1 - (1 - (R_h * Myt / Mp)) * ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] * (Mp / Myt)$ 1.101
 Mp / Myt 1.152

R_{pt} : 1.101 *Use if Web is Noncompact*

R_{pt} (FINAL): 1.101

Nominal Flexural Resistance - Ten: M_{nt} : 88155 kip-in

Project: MnDOT Special Structures - 69801J - Bridge 3A Pier 5
 Date: 4-Feb-10
 RisaSection Name: BR3A-P5-f

Project Number: 90147
 Eng: JDF
 Checked By:

55/21/10

Spreadsheet has been created for use with Box Steel Beam Caps Only.
 For sections with compact, non-compact, or slender flanges.
 For sections with compact or non-compact webs.

Yield Strengths:	F _{yc} :	36 ksi	F _{yt} :	36 ksi	F _{yw} :	36 ksi
Modulus of Elasticity:	E:	29000 ksi				
Compression Flange:	b _{fc} :	36 in	t _{fc} :	0.75 in		
Tension Flange:	b _{tc} :	36 in	t _{tc} :	0.75 in		
Webs:	D:	65.688 in	tw:	0.5 in		
Clear Space between webs:		30 in				
Unbraced Length:	L _b :	125.1 in				
Neutral Axis:	Y-bar (Comp)	33.594 in	Y bar (Ten)	33.594 in	X-bar	18 in
Moment of Inertia:	I _{xx}	83210 in ⁴	I _{yy}	21110 in ⁴		
Section Modulus:	S _x (Comp)	2476.95 in ³	S _x (Ten)	2476.95 in ³	S _y	1317 in ³
Radius:	r _x	26.367 in	r _y	13.281 in		
Plastic Modulus:	Z _x	2872.53 in ³	Z _y	1487.73 in ³		
Torsional Constant:	J	15.514 in ⁴				

Based on AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition, 2007, With 2008 & 2009 Interim Revisions

Article 6.10 - I-Section Flexural Members

Article 6.10.6 - Strength Limit State

Article 6.10.6.2 - Flexure

Article 6.10.6.2.3 - Composite Sections in Negative Flexure and Noncomposite Sections

If the following conditions are met, proportion the section according to the provisions for compact or noncompact web sections specified in Appendix A. Otherwise, the section shall be proportioned according to provisions specified in Article 6.10.8.

Depth of Web in Comp:	D _c :	32.844 in
Moment of Inertia Comp Flange:	I _{yc} :	2916.0 in ⁴
Moment of Inertia Tens Flange:	I _{yt} :	2916.0 in ⁴

Yield Strength Limit:	Max F _y :	36 ksi	Limit F _y :	70 ksi	OK - Keep Going
Web Slenderness Limit (slender):	2*D _c /tw:	131.376	5.7*(E/F _{yc}) ^{0.5} :	161.8 ksi	OK - Keep Going
Flange Ratio:	I _{yc} /I _{yt} :	1	Limit:	0.3	OK - Keep Going

Appendix A6: Flexural Resistance of Straight Composite I-Sections in Negative Flexure and Straight Non-composite I-sections with Compact or Noncompact Webs

Article A6.1 - General - Same as Article 6.10.6.2.3 above.

Article A6.1.1 - Sections with Discretely Braced Compression Flanges

At the limit state the following requirement shall be satisfied: $M_u + (1/3) * f_l * S_{xc} \leq \phi(f) * M_{nc}$

Bending Moment - Major Axis:	M _u :	Varies, see Risa 3D
Flange Lateral Bending Stress:	f _l :	See Article 6.10.1.6

Flange lateral bending stress, f_l, may be determined directly from first-order elastic analysis in discretely braced compression flanges for which: $b \leq 1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{0.5}$

Limiting Unbraced Length:	L _p :	See Article 6.10.8.2.3
	L _p :	1.0 * r _t * (E/F _{yc}) ^{0.5}
Effective Radius of Gyration:	r _t :	$b_{fc} / (12 * (1 + (1/3) * (D_c * tw / (b_{fc} * t_{fc}))))^{0.5}$
	r _t :	9.5 in
	L _p :	269.0 in

Moment Gradient Modifier:	C _b :	See Article 6.10.8.2.3 or Article A6.3.3, as applicable
	C _b :	1 Since M _{mid} /M ₂ > 1 at most situations. May be conservative at some locations.

Web Load-shedding Factor:	R _b :	See Article 6.10.1.10.2 1.0 if 2*D _c /tw ≤ λ _{da} (rw)
Web Slenderness Limit (noncompact):	λ _{da} (rw):	5.7*(E/F _{yc}) ^{0.5} 161.8
	2*D _c /tw:	131.376
	R _b :	1

Major Axis Bending to Yield Moment:	M _u /M _{yc} :	1 Assume 1.0. Conservative.
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Unbraced Limit for f _l :	L _b :	125.1 in	1.2 * L _p * (C _b * R _b / (M _u / M _{yc})) ^{0.5}	322.7 in	OK - Keep Going, First-order elastic analysis
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Flange Lateral Bending Stress:	f _l :	M _u /S _y First-order elastic analysis
Factored Weak Axis Bending Moment:	M _{uy} :	See Risa

Resistance Factor for Flexure:	φ(f):	1 As specified in Article 6.5.4.2
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Nominal Flexural Resistance:	M _{nc} :	See Article A6.3
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Nominal Flexural Resistance based on compression flange, M_{nc}, shall be taken as the smaller of the local buckling resistance determined as specified in Article A6.3.2, and the lateral torsional buckling resistance determined as specified in Article A6.3.3.

Article A6.3.2 - Local Buckling Resistance:

Determine if the compression flange is compact:

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Limiting Slenderness Ratio for Compact Flange:

Use two ratios, one for the flange between the webs, and the other for the flange overhang. See AISC Table B4.1.

Case 12: Uniform compression in flanges of rectangular box and hollow structural sections of uniform thickness subject to bending or compression.

λ_{mf}	b/t	40.00 <i>Clear space between webs/t_f</i>
λ_{mpf}	$1.12 \cdot (E/F_y)^{0.5}$	31.79
λ_{mrf}	$1.40 \cdot (E/F_y)^{0.5}$	39.74

Case 12: Slender Flange

Case 2: Flexure in flanges of doubly and singly symmetric I-shaped built-up sections.

λ_{mf}	b/t	3.67 <i>Flange overhang measured from mid-web/t_f</i>
λ_{mpf}	$0.38 \cdot (E/F_y)^{0.5}$	10.79
λ_{mrf}	$0.95 \cdot (E \cdot k_c / F_y)^{0.5}$	19.07
k_c	$4 / (D/t_w)^{0.5}$	0.35 but $0.35 \leq k_c \leq 0.76$

 k_c : 0.35F_y: smaller of 3 items below:

$0.7 \cdot F_{yc}$	25.2 ksi
$R_h \cdot F_{yt} \cdot S_{xt} / S_{xc}$	36.0 ksi
F _{yw}	36.0 ksi
but not less than:	
$0.5 \cdot F_{yc}$	18.0 ksi

F_y: 25.2 ksi

Case 2: Compact Flange

If Case 2 Flange is Noncompact or Slender, then check λ das used.

Slender Flange

Worse condition of Case 12 and Case 2

Compression Flange:

Nominal Flexural Resistance:

M_{nc}: $[1 - (1 - F_{yr} \cdot S_{xc}) / (R_{pc} \cdot M_{yc}) \cdot (\lambda_{mf} - \lambda_{mpf}) / (\lambda_{mrf} - \lambda_{mpf})] \cdot R_{pc} \cdot M_{yc}$

Equation A6.3.2-1 or A6.3.2-2

Web Plastification Factor - Comp:

R_{pc}: See Article A6.2.1 or A6.2.2, as applicable

Article A6.2.1 - Compact Web Sections:

Determine if the web is compact:

Compact if $2 \cdot D_{cp} / t_w \leq \lambda_{mp}$ (pw(D_{cp}))

Depth of Web in Comp at Plastic Mom:

D_{cp}: See Article D6.3.2For non composite sections where: $F_{yw} \cdot A_w \geq F_{yc} \cdot A_c - F_{yt} \cdot A_t$, $D_{cp} = D / (2 \cdot A_w \cdot F_{yw}) [F_{yt} \cdot A_t + F_{yw} \cdot A_w - F_{yc} \cdot A_c]$, otherwise $D_{cp} = D$.F_{yw} · A_w: 2364.768 kip $[F_{yc} \cdot A_c - F_{yt} \cdot A_t]$: 0 kip Use $2 \cdot D \cdot t_w$ for A_w due to two websD_{cp}: 32.8 in

Limiting Slenderness Ratio for Compact Web:

 λ_{mp} (pw(D_{cp})): $((E/F_y)^{0.5}) / (0.54 \cdot (M_p / (R_h \cdot M_y)) - 0.09)^{0.2} \leq \lambda_{mp}$ (rw) · (D_{cp}/D_c)

Plastic Moment

M_p: See Article D6.1

Article D6.1 - Plastic Moment:

M_p: See Table D6.1-2, Case IM_p: $P_w / (2 \cdot D) \cdot [Y(\bar{y})^2 + (D - Y(\bar{y}))^2] + [P_{rt} \cdot d_t + P_{rb} \cdot d_{rb} + P_t \cdot d_t + P_c \cdot d_c]$ Y($\bar{y}$): $(D/2) \cdot [(P_c - P_t - P_{rt} - P_{rb}) / P_w + 1]$ P_c: F_{yc} · b_c · t_c: 972 kipP_t: F_{yt} · b_t · t_t: 972 kipP_{rt}: 0 no concrete reinforcing steelP_{rb}: 0 no concrete reinforcing steelP_w: F_{yw} · D · t_w: 2364.768 kip

This is multiplied by 2 due to two webs

Y($\bar{y}$): 32.844d_t: 0 no concrete reinforcing steeld_{rb}: 0 no concrete reinforcing steeld_t: Y($\bar{y}$) + t_t / 2 33.219 ind_c: D - Y($\bar{y}$) + t_c / 2 33.219 inM_p: 103412 kip-in

Hybrid factor:

R_h: See Article 6.10.1.10.1R_h: 1

Yield Moment

M_y: Smaller of M_{yc} and M_{yt}, See Article D6.2.M_{yc}: F_{yc} · S_{xc} 89170 kip-inM_{yt}: F_{yt} · S_{xt} 89170 kip-inM_y: 89170.2 kip-in λ_{mp} (pw(D_{cp})): smaller of $((E/F_y)^{0.5}) / (0.54 \cdot (M_p / (R_h \cdot M_y)) - 0.09)^{0.2}$ 98.7 λ_{mp} (rw) · (D_{cp}/D_c) 161.8 λ_{mp} (pw(D_{cp})): 98.7

Web Compact?

 $2 \cdot D_{cp} / t_w$ 131.4 λ_{mp} (pw(D_{cp})): 98.7

Web is not compact, See Article A6.2.2

Web Plastification Factor - Comp: R_{pc}: M_p/M_{yc}: 1.160

Article A6.2.2 - Noncompact Web Sections

Verify the webs are non-compact and not slender.

If $\lambda_{mp}(w) < \lambda_{mp}(rw)$, then noncompact.

Slenderness ratio for web:

 $\lambda_{mp}(w)$: $2 \cdot D_{cp} / t_w$: 131.376

Limiting Slenderness ratio for noncompact web:

 $\lambda_{mp}(rw)$: $5.7 \cdot (E/F_y)^{0.5}$: 161.8

Noncompact vs Slender webs?

Noncompact, keep going

Web Plastification Factor - Comp:

R_{pc}: smaller of $[1 - (R_h \cdot M_{yc} / M_p)] \cdot ((\lambda_{mp}(w) - \lambda_{mp}(pw(D_{cp}))) / (\lambda_{mp}(rw) - \lambda_{mp}(pw(D_{cp})))) \cdot (M_p / M_{yc})$
M_p/M_{yc}

Limiting Slenderness ratio for a compact web:

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$\lambda(pw(Dc))$: smaller of $\lambda(pw(Dcp)) \cdot (Dc/Dcp)$
 $\lambda(pw(Dcp)) \cdot (Dc/Dcp)$ 98.7
 $\lambda(pw(Dc))$: 98.7

$[1 - (1 - (R_h \cdot Myc/Mp)) \cdot ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] \cdot (Mp/Myc)$ 1.077
 Mp/Myc 1.160

R_{pc} : 1.077 *Use if Web is Noncompact*

Web Plastification Factor - Comp: R_{pc} (FINAL): 1.077

Nominal Flexural Resistance - comp: M_{nc} : 61299 kip-in Per Article A6.3.2

Article A6.3.3 - Lateral Torsional Buckling Resistance:

If $L_b \leq L_p$, then $M_{nc} = R_{pc} \cdot Myc$
 $L_b \leq L_p$, therefore $M_{nc} = R_{pc} \cdot Myc$ (Same as A6.3.2)
 M_{nc} : 96035 kip-in Per Article A6.3.3

Nominal Flexural Resistance - Comp: M_{nc} : 61299 kip-in

A6.4 - Flexural Resistance Based on Tension Flange Yielding

Nominal Flexural Resistance - tension: M_{nt} : $R_{pt} \cdot Myt$

Web Plastification Factor - Ten: R_{pt} : See Article A6.2.1 or Article A6.2.2 as applicable.

Article A6.2.1 - Compact Web Sections

R_{pt} : Mp/Myt 1.160 *Use if Web is Compact*

Article A6.2.2 - Noncompact Web Sections

R_{pt} : smaller of $[1 - (1 - (R_h \cdot Myt/Mp)) \cdot ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] \cdot (Mp/Myt)$
 Mp/Myt

$[1 - (1 - (R_h \cdot Myt/Mp)) \cdot ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] \cdot (Mp/Myt)$ 1.077
 Mp/Myt 1.160

R_{pt} : 1.077 *Use if Web is Noncompact*

R_{pt} (FINAL): 1.077

Nominal Flexural Resistance - Ten: M_{nt} : 96035 kip-in

Project: MnDOT Special Structures - 69801J - Bridge 3A Pier 5
Date: 4-Feb-10
RisaSection Name: BR3A-P5-g

Project Number: 90147
Eng: JDF
Checked By:

Spreadsheet has been created for use with Box Steel Beam Caps Only.
For sections with compact, non-compact, or slender flanges.
For sections with compact or non-compact webs.

Yield Strengths:	F _{yc} :	36	ksi	F _{yt} :	36	ksi	F _{yw} :	36	ksi
Modulus of Elasticity:	E:	29000	ksi						
Compression Flange:	b _{fc} :	36	in	t _{fc} :	1.5	in			
Tension Flange:	b _{ft} :	36	in	t _{ft} :	0.75	in			
Webs:	D:	64.313	in	t _w :	0.5	in			
Clear Space between webs:		30	in						
Unbraced Length:	L _b :	125.1	in						
Neutral Axis:	Y-bar (Comp)	27.478	in	Y bar (Ten)	39.085	in	X-bar	18	in
Moment of Inertia:	I _{xx} :	103700	in ⁴	I _{yy} :	23710	in ⁴			
Section Modulus:	S _x (Comp)	3773.13	in ³	S _x (Ten)	2652.65	in ³	S _y	1317	in ³
Radius:	r _x :	26.711	in	r _y :	12.773	in			
Plastic Modulus:	Z _x :	3507.41	in ³	Z _y :	1709.77	in ³			
Torsional Constant:	J:	50.4	in ⁴						

Based on AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition, 2007, With 2008 & 2009 Interim Revisions

Article 6.10 - I-Section Flexural Members

Article 6.10.6 - Strength Limit State

Article 6.10.6.2 - Flexure

Article 6.10.6.2.3 - Composite Sections in Negative Flexure and Noncomposite Sections

If the following conditions are met, proportion the section according to the provisions for compact or noncompact web sections specified in Appendix A. Otherwise, the section shall be proportioned according to provisions specified in Article 6.10.8.

Depth of Web in Comp:	D _c :	25.978	in
Moment of Inertia Comp Flange:	I _{yc} :	5832.0	in ⁴
Moment of Inertia Tens Flange:	I _{yt} :	2916.0	in ⁴

Yield Strength Limit:	Max F _y :	36	ksi	Limit F _y :	70	ksi	OK - Keep Going
Web Slenderness Limit (slender):	2*D _c /t _w :	103.912		5.7*(E/F _{yc}) ^{0.5} :	161.8	ksi	OK - Keep Going
Flange Ratio:	I _{yc} /I _{yt} :	2		Limit:	0.3		OK - Keep Going

Appendix A6: Flexural Resistance of Straight Composite I-Sections in Negative Flexure and Straight Non-composite I-sections with Compact or Noncompact Webs

Article A6.1 - General - Same as Article 6.10.6.2.3 above.

Article A6.1.1 - Sections with Discretely Braced Compression Flanges

At the limit state the following requirement shall be satisfied:

$$M_u + (1/3) * f_l * S_{xc} \leq \phi(f) * M_{nc}$$

Bending Moment - Major Axis:	M _u :	Varies, see Risa 3D
Flange Lateral Bending Stress:	f _l :	See Article 6.10.1.6

Flange lateral bending stress, f_l , may be determined directly from first-order elastic analysis in discretely braced compression flanges for which: $b \leq 1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{0.5}$

Limiting Unbraced Length:	L _p :	See Article 6.10.8.2.3
	L _p :	$1.0 * r_t * (E / F_{yc})^{0.5}$
Effective Radius of Gyration:	r _t :	$b_{fc} / (12 * (1 + (1/3) * (D_c * t_w / (b_{fc} * t_{fc}))))^{0.5}$
	r _t :	10.0 in
	L _p :	283.8 in

Moment Gradient Modifier:	C _b :	See Article 6.10.8.2.3 or Article A6.3.3, as applicable
	C _b :	1 Since $M_{mid} / M_2 > 1$ at most situations. May be conservative at some locations.

Web Load-shedding Factor:	R _b :	See Article 6.10.1.10.2	1.0 if $2 * D_c / t_w \leq \lambda_{rw}$
Web Slenderness Limit (noncompact):	λ_{rw} :	$5.7 * (E / F_{yc})^{0.5}$	161.8
	2*D _c /t _w :	103.912	
	R _b :	1	

Major Axis Bending to Yield Moment:	M _u /M _{yc} :	1 Assume 1.0. Conservative.
-------------------------------------	-----------------------------------	-----------------------------

Unbraced Limit for f _l :	L _b :	125.1 in	$1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{0.5}$	340.6 in	OK - Keep Going, First-order elastic analysis
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Flange Lateral Bending Stress:	f _l :	M _{uy} /S _y	First-order elastic analysis
Factored Weak Axis Bending Moment:	M _{uy} :	See Risa	

Resistance Factor for Flexure:	$\phi(f)$:	1 As specified in Article 6.5.4.2
--------------------------------	-------------	-----------------------------------

Nominal Flexural Resistance:	M _{nc} :	See Article A6.3
------------------------------	-------------------	------------------

Nominal Flexural Resistance based on compression flange, M_{nc} , shall be taken as the smaller of the local buckling resistance determined as specified in Article A6.3.2, and the lateral torsional buckling resistance determined as specified in Article A6.3.3.

Article A6.3.2 - Local Buckling Resistance:

Determine if the compression flange is compact:

Limiting Slenderness Ratio for Compact Flange:

Use two ratios, one for the flange between the webs, and the other for the flange overhang. See AISC Table B4.1.

Case 12: Uniform compression in flanges of rectangular box and hollow structural sections of uniform thickness subject to bending or compression.

λ_{mf}	b/t	20.00 <i>Clear space between webs/t_{fc}</i>
λ_{mpf}	$1.12 \sqrt{E/F_y}$	31.79
λ_{mrf}	$1.40 \sqrt{E/F_y}$	39.74

Case 12: Compact Flange

Case 2: Flexure in flanges of doubly and singly symmetric I-shaped built-up sections.

λ_{mf}	b/t	1.83 <i>Flange overhang measured from mid-web/t_{fc}</i>
λ_{mpf}	$0.38 \sqrt{E/F_y}$	10.79
λ_{mrf}	$0.95 \sqrt{E/k_c/F_y}$	19.14
k_c	$4/(D/t_w)^{1.5}$	0.35 but $0.35 \leq k_c \leq 0.76$

 k_c : 0.35F_{yr}: smaller of 3 items below:

$0.7 F_{yc}$	25.2 ksi
$R_h F_{yt} S_{xt} / S_{xc}$	25.3 ksi
F _{yw}	36.0 ksi
but not less than:	
$0.5 F_{yc}$	18.0 ksi

F_{yr}: 25.2 ksi

Case 2: Compact Flange

If Case 2 Flange is Noncompact or Slender, then check λ mdas used.

Compact Flange Worse condition of Case 12 and Case 2

Compression Flange:

Nominal Flexural Resistance:

M_{nc}: M_{nc} = R_{pc} M_{yc}

Equation A6.3.2-1 or A6.3.2-2

Web Plastification Factor - Comp:

R_{pc}: See Article A6.2.1 or A6.2.2, as applicable

Article A6.2.1 - Compact Web Sections:

Determine if the web is compact:

Compact if $2 D_{cp} / t_w \leq \lambda_{mw}(D_{cp})$

Depth of Web in Comp at Plastic Mom:

D_{cp}: See Article D6.3.2For non composite sections where: $F_{yw} A_w = [F_{yc} A_c - F_{yt} A_t]$, $D_{cp} = D / (2 A_w F_{yw}) [F_{yt} A_t + F_{yw} A_w - F_{yc} A_c]$, otherwise $D_{cp} = D$.F_{yw} A_w: 2315.268 kip | F_{yc} A_c - F_{yt} A_t: 972 kipUse $2 D^* t_w$ for A_w due to two websD_{cp}: 18.7 in

Limiting Slenderness Ratio for Compact Web:

 $\lambda_{mw}(D_{cp})$: $((E/F_y)^{1.5}) / (0.54 (M_p / (R_h M_y)) - 0.09)^{1/2} \leq \lambda_{mrw} (D_{cp} / D_c)$

Plastic Moment

M_p: See Article D6.1

Article D6.1 - Plastic Moment:

M_p: See Table D6.1-2, Case IM_p: $P_w / (2 D^*) [Y(\bar{b})^2 + (D - Y(\bar{b}))^2] + [P_{rt} d_{rt} + P_{rb} d_{rb} + P_t d_t + P_c d_c]$ Y($\bar{b}$): $(D/2) * [(P_c - P_t - P_{rt} - P_{rb}) / P_w + 1]$ P_c: F_{yc} b_c t_c: 1944 kipP_t: F_{yt} b_t t_t: 972 kipP_{rt}: 0 no concrete reinforcing steelP_{rb}: 0 no concrete reinforcing steelP_w: F_{yw} D^* t_w: 2315.268 kip

This is multiplied by 2 due to two webs

Y($\bar{b}$): 45.6565d_{rt}: 0 no concrete reinforcing steeld_{rb}: 0 no concrete reinforcing steeld_t: Y($\bar{b}$) + t_w/2 46.0315 ind_c: D - Y($\bar{b}$) + t_w/2 19.4065 inM_p: 126255.3 kip-in

Hybrid factor:

R_h: See Article 6.10.1.10.1R_h: 1

Yield Moment

M_y: Smaller of M_{yc} and M_{yt}, See Article D6.2.M_{yc}: F_{yc} S_{xc} 135833 kip-inM_{yt}: F_{yt} S_{xt} 95495 kip-inM_y: 95495.4 kip-in $\lambda_{mw}(D_{cp})$: smaller of $((E/F_y)^{1.5}) / (0.54 (M_p / (R_h M_y)) - 0.09)^{1/2}$ 72.9 $\lambda_{mrw} (D_{cp} / D_c)$ 116.2 $\lambda_{mw}(D_{cp})$: 72.9

Web Compact?

 $2 D_{cp} / t_w$ 74.6 $\lambda_{mw}(D_{cp})$: 72.9

Web is not compact, See Article A6.2.2

Web Plastification Factor - Comp: R_{pc}: M_p/M_{yc}: 0.829 *See Article A6.2.2*

Article A6.2.2 - Noncompact Web Sections

Verify the webs are non-compact and not slender.

If $\lambda_{mw}(w) < \lambda_{mrw}$, then noncompact.

Slenderness ratio for web:

 $\lambda_{mw}(w)$: $2 D_{cp} / t_w$ 103.912

Limiting Slenderness ratio for noncompact web:

 λ_{mrw} : $5.7 \sqrt{E/F_y}$ 161.8

Noncompact vs Slender webs?

Noncompact, keep going

Web Plastification Factor - Comp:

R_{pc}:

smaller of

 $[1 - (1 - R_h M_{yc} / M_p)] * ((\lambda_{mw}(w) - \lambda_{mw}(D_{cp})) / (\lambda_{mrw} - \lambda_{mw}(D_{cp}))) * (M_p / M_{yc})$
M_p/M_{yc}

Limiting Slenderness ratio for a compact web:

$\lambda(pw(Dc))$: smaller of $\lambda(pw(Dcp)) * (Dc/Dcp)$
 $\lambda(pw(Dc))$: $\lambda(rw)$
 $\lambda(pw(Dcp)) * (Dc/Dcp)$ 101.5
 $\lambda(pw(Dc))$: 101.5

$[1 - (1 - (R_h * Myc / Mp)) * ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] * (Mp / Myc)$ 0.932
 Mp / Myc 0.929

Rpc: 0.929 Use if Web is Noncompact

Web Plastification Factor Comp: Rpc (FINAL): 1.309

Nominal Flexural Resistance - comp: Mnc: 177847 kip-in Per Article A6.3.2

Article A6.3.3 - Lateral Torsional Buckling Resistance:

If $L_b \leq L_p$, then $M_{nc} = R_{pc} * Myc$
 $L_b \leq L_p$, therefore $M_{nc} = R_{pc} * Myc$ (Same as A6.3.2)
 Mnc: 177847 kip-in Per Article A6.3.3

Nominal Flexural Resistance - Comp: Mnc: 177847 kip-in

← Error!

A6.4 - Flexural Resistance Based on Tension Flange Yielding

Nominal Flexural Resistance - tension: Mnt: Rpt * Myt

Web Plastification Factor - Ten: Rpt: See Article A6.2.1 or Article A6.2.2 as applicable.

Article A6.2.1 - Compact Web Sections

Rpt: Mp / Myt 1.322 Use if Web is Compact

Article A6.2.2 - Noncompact Web Sections

Rpt: smaller of $[1 - (1 - (R_h * Myt / Mp)) * ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] * (Mp / Myt)$
 Mp / Myt

$[1 - (1 - (R_h * Myt / Mp)) * ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] * (Mp / Myt)$ 1.309
 Mp / Myt 1.322

Rpt: 1.309 Use if Web is Noncompact

Rpt (FINAL): 1.309

Nominal Flexural Resistance - Ten: Mnt: 125033 kip-in



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PROJECT # 090147 DATE 2.4.10 BY jdf SHEET NO. 1 OF 1

jdf
vcn
5/12/10

Follow Article 6.10 in LRFD for I-shaped members.
Check provisions of 6.10.1 and 6.10.6

See 6.10.6 for strength Limit States @ Section 5g

See 6.10.6.2.3 for Non-composite Sections.

- $F_y = 36 \text{ ksi}$ OK ✓
- $\frac{2D_c}{t_w} = \frac{2 \times 25.98}{.5} = 103.92 < 5.7 \sqrt{\frac{E}{F_y}} = 5.7 \sqrt{\frac{29000}{36}} = 161.8$ ✓
OK
- $D_c = 27.478 - 1.5 = 25.98$ ✓
- $I_{yc} = 1.5 \times 36^3 / 12 = 5832 \text{ in}^4$ ✓
- $I_{yt} = .75 \times 36^3 / 12 = 2916 \text{ in}^4$ ✓
- $\frac{I_{yc}}{I_{yt}} = 2.0 \geq 0.3 \text{ OK}$ ✓

Since these three provisions are met, proportion per Appendix A (Not 6.10.8).

A6.1.1.

$$M_u + \frac{1}{3} f_L S_{xc} \leq \phi_f M_{nc} \quad \checkmark$$

M_u varies, See Risa

f_L = flange Lateral Bending Stress, Article 6.10.1.6

Use first-order elastic analysis if:

$$L_b \leq 1.2 L_p \sqrt{\frac{C_b R_o}{m_u / m_{yc}}} \quad \checkmark$$

$$L_b = \text{unbraced length} = 11' - 9 \frac{5}{8}" = 125.1" \quad \checkmark$$

$$L_p \Rightarrow \text{Article 6.10.8.2.3}$$

$$= 1.0 c_t \sqrt{E / F_{yc}} \quad \checkmark$$



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$$r_t = \frac{b_{fc}}{\sqrt{12 \left(1 + \frac{1}{3} \frac{D_c t_w}{b_{fc} t_c} \right)}} = \frac{36}{\sqrt{12 \left(1 + \frac{1}{3} \times \frac{25.98 \times 5}{36 \times 1.5} \right)}} = 10.0 \quad \checkmark$$

$$L_p = 1.0 \times 10.0 \sqrt{\frac{29,000}{36}} = 283.8'' \quad \checkmark$$

$$C_b \Rightarrow 1.0, \text{ See A6.3.3}$$

$$R_b \Rightarrow \text{See 6.10.1.10.2}$$

$$\text{Since } \frac{2D_c}{t_w} = 103.92 \leq \lambda_{rw} = 161.8 \quad R_b = 1.0 \quad \checkmark$$

$$\text{Assume } m_u/m_y = 1.00 \quad \checkmark$$

$$L_b = 125.1'' \leq 1.2 \times 283.8 \sqrt{\frac{1.0 \times 1.0}{1.0}} = 340.56'' \quad \checkmark$$

∴ Use first order analysis

$$f_e = \frac{m_u}{S_y}$$

M_u varies, See Risa

$$S_y = 1317.0 \text{ in}^3 \quad \checkmark$$

$$S_{xc} = S_x(\text{bot}) = 3773.13 \text{ in}^3 \quad \checkmark$$

$$\phi_f = 1.0 \text{ for flexure}$$

$$M_{nc} \Rightarrow \text{See A6.3} \Rightarrow \text{Smaller of A6.3.2 \& A6.3.3}$$

A6.3.2 Local Buckling Resistance

$$\text{does } \lambda_f \leq \lambda_{pf} ?$$



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$$\lambda_f = \frac{b_{fc}}{2t_{fc}} = \frac{36}{2 \times 1.5} = 12 \checkmark$$

$\lambda_{pf} \Rightarrow$ Use AISC criteria

between webs = $1.12 \sqrt{E/F_{yc}} = 31.8 \checkmark$
compare to $\frac{D}{t} = \frac{30}{1.5} = 20 \checkmark$ OK

flange overhang = $0.38 \sqrt{E/F_{yc}} = 10.79$
compare to $2.75/1.5 = 1.83 \checkmark$ OK

$\therefore$ compact Flange, Use A6.3.2-1

$$M_{nc} = R_{pc} M_{yc} \checkmark$$

R_{pc} = web plastification factor. See A6.2.1 or A6.2.2

If compact web use A6.2.1 otherwise go to A6.2.2

Compact if: $\frac{2D_{cp}}{t_w} \leq \lambda_{pw}(D_{cp}) \checkmark$

D_{cp} = See D6.3.2

if $F_{yw} \times A_w \geq |F_{yc} A_c - F_{yt} A_t|$, then

$$D_{cp} = \frac{D}{2A_w F_{yw}} [F_{yt} A_t + F_{yw} A_w - F_{yc} A_c]$$

otherwise $D_{cp} = D$ $\checkmark$

$$F_{yw} \times A_w = 36 \times 2 \times 5 \times 64.313 = 2315 \text{ kip} \checkmark$$

$$|F_{yc} A_c - F_{yt} A_t| = |36 \times 1.5 \times 36 - 36 \times 36 \times 75| = 972 \text{ kip}$$

$$D_{cp} = \frac{64.313}{2 \times 2 \times 5 \times 64.313 \times 36} [36 \times 36 \times 75 + 36 \times 5 \times 2 \times 64.313 - 36 \times 1.5 \times 36]$$

$$= 18.68" \checkmark$$

$$t_w = 1/2" \checkmark$$

$$\lambda_{pw}(D_{cp}) = \frac{\sqrt{E/F_{yc}}}{\left(0.54 \frac{M_p}{R_{hmy}} - 0.09\right)^2} \leq \lambda_{rw} \left(\frac{D_{cp}}{D_c}\right) \checkmark$$



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$$M_p = F_y Z_x = 36 \text{ ksi} \times 3557.41 \text{ in}^3 = 126267 \text{ kip-in}$$

$$M_y = F_y S_x = 36 \times 2652.65 \text{ in}^3 = 95495 \text{ kip-in}$$

Use smaller of S_{xc} or S_{xt}

$R_h = 1.0$ since homogeneous, See 6.10.1.10.1

$$\lambda_{rw} = 5.7 \sqrt{E/F_y} = 161.8$$

$$D_c = 27.478 - 1.5 = 25.98$$

$$\lambda_{pw(Dcp)} = \sqrt{\frac{29000/36}{\left(0.54 \times \frac{126267}{1.0 \times 95495} - 0.09\right)^2}} = 72.89$$

$$\leq 161.8 \times \frac{18.7}{25.98} = 116.46$$

$$\lambda_{pw(Dcp)} = 72.89$$

$$\frac{2D_{cp}}{t_w} = \frac{2 \times 18.68}{.5} = 74.72 > \lambda_{pw(Dcp)} = 72.89$$

" Section is not compact, go to A6.2.2

A6.2.2. Verify web is not slender, $\lambda_w < \lambda_{rw}$

$$\lambda_w = \frac{2D_c}{t_w} = \frac{2 \times 25.98}{.5} = 103.92$$

$$\lambda_{rw} = 5.7 \sqrt{E/F_y} = 161.8$$

Since $\lambda_w < \lambda_{rw}$, we are noncompact web, Use A6.2.2-4

$$R_{pc} = \left[1 - \left(1 - \frac{R_h M_{yc}}{M_p} \right) \left(\frac{\lambda_w - \lambda_{pw(Dcp)}}{\lambda_{rw} - \lambda_{pw(Dcp)}} \right) \right] \frac{M_p}{M_{yc}} \leq \frac{M_p}{M_{yc}}$$

$$\lambda_{pw(pc)} = \lambda_{pw(Dcp)} \left(\frac{D_c}{D_{cp}} \right) = 72.89 \times \frac{25.98}{18.68} = 101.37$$

$$M_{yc} = 36 \text{ ksi} \times 3773.13 \text{ in}^3 = 135833 \text{ kip-in}$$

$$R_{pc} = \left[1 - \left(1 - \frac{1.0 \times 135833}{126267} \right) \left(\frac{103.92 - 101.37}{161.8 - 101.37} \right) \right] \frac{126267}{135833} \leq \frac{126267}{135833}$$

$$= 1.00320 \times 0.9296 = 0.9325 \leq 0.9296$$

controls

$$R_{pc} = 0.9296$$

$$M_{nc} = 0.9296 \times 135833 = 126270 \text{ kip-in (per A6.3.2) V-24}$$



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Check M_{nc} per A6.3.3: Lateral Torsional Buckling

If $L_b < L_p$, then $M_{nc} = R_{pc} M_{yc}$

$$L_b = 125.1" \checkmark$$

$$L_p = 283.8" \checkmark$$

$L_b < L_p \therefore M_{nc} = R_{pc} \times M_{yc}$, same as A6.3.2.

$$M_{nc} = 126270 \text{ kip}\cdot\text{in} \checkmark$$

Tension Flange Yielding A6.4.

$$M_{nt} = R_{pt} M_{yt} \checkmark$$

R_{pt} See Article A6.2.1 or A6.2.2 as applicable.
A6.2.2 is applicable since we have noncompact webs.

$$R_{pt} = \left[1 - \left(1 - \frac{R_{m} M_{yt}}{M_p} \right) \left(\frac{\lambda_w - \lambda_{pw(0.1)}}{\lambda_{rw} - \lambda_{pw(0.1)}} \right) \right] \frac{M_p}{M_{yt}} \leq \frac{M_p}{M_{yt}}$$

$$M_{yt} = 36 \text{ ksi} \times 2652.65 \text{ in}^3 = 95495 \text{ kip}\cdot\text{in}$$

$$R_{pt} = \left[1 - \left(1 - \frac{1.0 \times 95495}{126267} \right) \left(\frac{103.92 - 101.37}{161.8 - 101.37} \right) \right] \frac{126267}{95495} \leq \frac{126267}{95495}$$

$$= 0.9897 \times 1.322 = 1.3086 \leq 1.322$$

↑ controls.

$$R_{pt} = 1.3086 \checkmark$$

$$M_{nt} = 1.3086 \times 95495 = 124965 \text{ kip}\cdot\text{in} \checkmark$$

$$M_{nt} = 124965 \text{ kip}\cdot\text{in} \checkmark$$



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Determine V_n using Article 6.10.9

Section 5b (North end or South end) ✓

Stiffener spacing = $3'-0\frac{3}{16}" = 36.2"$ ✓

End panel: 6.10.9.3.3

$$V_n = V_{cr} = C V_p \quad \checkmark$$

$C \Rightarrow$ See 6.10.9.3.2-4, -5, or -6 based on $\frac{D}{t_w}$

$$D = 33" \quad \checkmark$$

$$t_w = \frac{1}{2} \quad \checkmark$$

$$D/t_w = 66$$

If $\frac{D}{t_w} \leq 1.12 \sqrt{\frac{E}{F_{yw}}}$ then use 6.10.9.3.2-4

$$k = 5 + \frac{5}{\left(\frac{D}{t_w}\right)^2} = 5 + \frac{5}{\left(\frac{36.2}{33}\right)^2} = 9.16 \quad \checkmark$$

$$d_o = \text{stiffener spacing} = 36.2" \quad \checkmark$$

$$D = 33" \quad \checkmark$$

$$\frac{D}{t_w} = 66 \leq 1.12 \sqrt{\frac{29000 \times 9.16}{36}} = 96.2 \quad \therefore \text{use } 6.10.9.3.2-4$$

$$C = 1.0 \quad \checkmark$$

$$V_p = 0.58 F_{yw} D t_w \quad \checkmark$$

$$= 0.58 \times 36 \times 33 \times 5 \times 2 = 689.0 \text{ kip}$$

↖ 2 webs

$$V_n = V_{cr} = 1.0 \times 689.0 = 689.0 \text{ kip.}$$



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PROJECT MnDOT SS-69801 J - 3A-PS - Shear strength -2
PROJECT # 090147 DATE 2/10/10 BY jaf SHEET NO. 5/12/10 OF 10

Section 5:

Stiffener Spacing = $3' - 0\frac{7}{8}" = 36.9" = d_o$ (conservative)

Interior panel:

check $\frac{2Dt_w}{(b_{f,fc} + b_{f,fr})} \leq 2.5$ ✓

$D = 57.31"$

$t_w = .5$

$\frac{2 \times 57.31 \times .5 \times 2}{(36 \times .75) \times 2} = 2.13 < 2.5$ ✓ OK

$V_n = V_p \left[C + \frac{0.85(1-C)}{\sqrt{1 + \left(\frac{d_o}{D}\right)^2}} \right]$

$V_p = 0.58 F_y D t_w = 0.58 \times 36 \times 57.31 \times .5 \times 2$
 $= 1197 \text{ kip}$ ✓

$C \rightarrow \frac{D}{t_w} = \frac{57.31}{.5} = 114.6$ ✓

$k = 5 + \frac{5}{\left(\frac{d_o}{D}\right)^2} = 5 + \frac{5}{\left(\frac{36.9}{57.31}\right)^2} = 17.06$ ✓ OK

$1.12 \sqrt{\frac{E_k}{F_{yw}}} = 1.12 \sqrt{\frac{29000 \times 17.06}{36}} = 131.3$ ✓ OK

$\frac{D}{t_w} \leq 1.12 \sqrt{\frac{E_k}{F_{yw}}} \therefore C = 1.0$

$V_n = 1197 [1 + 0] = 1197 \text{ kip}$



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PROJECT MnDOT SS-69801 J-3A-P5- Shear Strength

-3

PROJECT # 090147

DATE 2/10/10

BY jdf

SHEET NO. _____

OF _____

VCSM
5/12/10

Section 5h

Stiffener Spacing = $3'-0\frac{7}{8}" = 36.9" = d_o$

$D = 61.75"$
OK

check $\frac{2D + t_w}{(b_{sc} + t_c + b_{fc} + t_c)} \leq 2.5$

$\frac{2 \times 61.75 \times .5 \times 2}{36 \times .75 \times 2} = 2.29 \leq 2.5$ OK
2 webs OK

$C \Rightarrow \frac{D}{t_w} = \frac{61.75}{.5} = 123.5$ OK

$k = 5 + \frac{5}{(8\%D)^2} = 5 + \frac{5}{(36.9/61.75)^2} = 19.00$ OK

$1.12 \sqrt{\frac{E_k}{F_{yw}}} = 1.12 \sqrt{\frac{29000 \times 19.0}{36}} = 138.6$ OK

Since $\frac{D}{t_w} \leq 1.12 \sqrt{\frac{E_k}{F_{yw}}}$, $C = 1.0$ ✓

$V_p = 0.58 F_{yw} D + t_w = 0.58 \times 36 \times 61.75 \times .5 \times 2$
 $= 1289$ kip. OK 2 webs

$V_n = V_p \left[C + \frac{0.85(1-C)}{\sqrt{1 + (\frac{D}{8})^2}} \right] = V_p \times C$

$V_n = 1289.0 \times 1.0 = 1289.0$ kip. OK

V-30



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PROJECT MnDOTSS-69801J-PS-3A- Transverse Stiffeners - 1
PROJECT # 090147 DATE 2/11/10 BY jdf SHEET NO. _____ OF _____

✓ LCM
5/12/10

Verify the transverse stiffeners meet the requirements of Article 6.10.11.1

Review Stiffener Type A:

3/8" thick, 5" wide @ minimum ✓

$$d_o = 36.11" \checkmark$$

D stiffener 52.2" ✓ (Section 5j) (3' North of Girder B)

$$b_t \geq 2.0 + \frac{D}{30} = 2.0 + \frac{52.2}{30} = 3.74" \checkmark \text{ OK } b_c = 5" \checkmark$$

$$16 t_p \geq b_t \geq \frac{b_c}{4} \Rightarrow 16 \times \frac{3}{8} = 6" \geq 5" \geq \text{NA} \text{ OK } \checkmark \text{ Use 5"} \checkmark$$

Determine V_u and $\phi_v V_c$

$$V_u = 1025 \times 100.9 + 1.75 \times 118.2 = 333.8 \text{ k} \checkmark$$

$$\phi_v = 1.0 \checkmark$$

$$V_c \Rightarrow \text{per 6.10.9.2, } V_c = C V_p$$

$$C \Rightarrow \text{Eq. 6.10.9.3.2-4 thru -6 w/ } k = 5.0 \checkmark$$

$$D/t_w = 61.81 / .5 = 123.6 \quad (D @ \text{ Girder B})$$

$$1.12 \sqrt{\frac{E k}{F_{yw}}} = 1.12 \sqrt{\frac{29000 \times 5}{36}} = 71.1 \checkmark$$

$$1.40 \sqrt{\frac{E k}{F_{yw}}} = 88.7 \checkmark$$

$$\text{Since } \frac{D}{t_w} > 1.4 \sqrt{\frac{E k}{F_{yw}}}, \text{ use 6.10.9.3.2-6} \checkmark$$

$$C = \left(\frac{D/t_w}{1.4 \sqrt{\frac{E k}{F_{yw}}}} \right)^2 = \frac{1.57}{123.6^2} \left(\frac{29000 \times 5}{36} \right) = 0.414 \checkmark$$

$$V_p = 0.58 \times F_{yw} D \times t_w = 0.58 \times 36 \times 61.81 \times .5 \times 2 = 1291 \text{ k}$$

$$V_c = 0.414 \times 1291 = 534.0 \text{ k} \checkmark$$

Since $V_u < \phi V_c$ - Use Smaller of 6.10.11.1.3-1 or -2.

$$I_t = \frac{b d^3}{3} = \frac{36 \times 5^3}{3} = 15.6 \text{ in}^4 \checkmark$$

$$I_{t1} = b t_w^3 \checkmark = 36 \times .5^3 \times 3.26 = 14.67 \text{ in}^4 \checkmark$$

$$\checkmark \frac{2.5}{(d_o/D)^2} - 2.0 \geq 0.5 \quad \frac{2.5}{(36/52.2)^2} - 2.0 = 3.26 \geq 0.5$$

V-31



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PROJECT MnDOT SS-69801 J - P5.3A - Transverse Stiffeners -2
PROJECT # 090147 DATE 2/11/10 BY jdf SHEET NO. _____ OF _____

Since $I_t > I_{t_1}$, we can stop, stiffener (A) is OK

Review Stiffener D:

$\frac{7}{16}$ above girder bottom flange, $b_t = 6"$ ✓
 $\frac{3}{8}$ below girder bottom flange (solid, full width).

Check as if it is a $\frac{3}{8}" \times 6"$ stiffener. ✓

d_o = smaller of adjacent web panel widths = $24\frac{1}{4}"$ ✓
 $D = 61.8"$ (Section 5k) e. Girder B. ✓
stiffener

$$b_t \geq 2.0 + \frac{D}{30} = 2.0 + \frac{61.8}{30} = 4.02" \text{ OK } b_t = 6" \text{ ✓}$$

$$16 t_p \geq b_t \geq \frac{b_t}{4} \Rightarrow 16 \times \frac{3}{8} = 6" \geq 6" \geq \text{NA} \text{ Use } 6" \text{ ✓}$$

Determine V_u and ϕV_c

$$V_u = 1.25 \times 226.93 + 1.75 \times 202.3 = 637.7 \text{ kip.}$$

$$\phi_v = 1.0$$

$$V_{cr} \Rightarrow \text{per 6.10.9.2 } V_{cr} = C V_p$$

$$C \Rightarrow \text{Eq. 6.10.9.3.2-4 thru -6 w/ } k = 5.0$$

$$\text{Lallest } D @ 5f = 65.7"$$

$$D/t_w = 65.7/1.5 = 131.4 \text{ ✓ } > 1.4 \sqrt{\frac{E k}{F_{yw}}}$$

$$\text{Use 6.10.9.3.2-6}$$

$$C = \frac{1.57}{(D/t_w)^2} \left(\frac{E k}{F_{yw}} \right) = \frac{1.57}{131.4^2} \left(\frac{29000 \times 5}{36} \right) = 0.366 \text{ ✓}$$

$$V_p = 0.58 \times F_{yw} \times D \times t_w = 0.58 \times 36 \times 65.7 \times 1.5 \times 2 = 1371.8 \text{ kip.}$$

$$V_{cr} = 0.366 \times 1371.8 = 502.1 \text{ kip.}$$

$$V_u > \phi V_c \therefore \text{Use 6.10.11.1.3-7 or -8}$$

$$I_t = \frac{b d^3}{3} = \frac{375 \times 6^3}{3} = 27 \text{ in}^4 \text{ ✓}$$



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PROJECT MnDOT SS-69801 J - PS-3A - Transverse Stiffeners

-3

PROJECT # 090147

DATE 2/11/10

BY jdf

SHEET NO. _____

OF _____

$$I_{t1} = b t_w^3 J$$

$$b = 24.25" \checkmark = d_o$$

$$t_w = .5" \checkmark$$

$$J = \frac{2.5}{(d_o/d)^2 - 2.0} \geq 0.5 \Rightarrow \frac{2.5}{(24.25/61.8)^2 - 2.0} = 14.24 \geq 0.5$$

$$D = 61.8" \checkmark$$

$$I_{t1} = 24.25 \times .5^3 \times 14.24 = 43.17 \text{ in}^4$$

$$I_{t2} = \frac{D^4 p_t^{1.3}}{40} \left(\frac{F_{yw}}{E} \right)^{1.5}$$

$$D = 61.8" \checkmark$$

$$p_t = \text{larger of } F_{yw}/F_{crs} \text{ and } 1.0$$

$$F_{crs} = \frac{0.31 E}{\left(\frac{b t}{t_p} \right)^2} \leq F_{ys} \Rightarrow \frac{0.31 \times 29000}{\left(\frac{6}{3/8} \right)^2} = 35.12 < 36$$

$$F_{yw}/F_{crs} = 36/35.12 = 1.025 \checkmark$$

$$I_{t2} = \frac{61.8^4 \times 1.025^{1.3}}{40} \left(\frac{36}{29000} \right)^{1.5} = 16.47 \checkmark$$

Since $I_{t2} > I_{t1}$, use 6.10.11.1.3-8

$$I_t \geq I_{t2} \rightarrow 27 \text{ in}^4 \geq 16.47 \text{ in}^4 \checkmark \text{ OK}$$

Stiffener (D) is OK

Review Stiffener E:

3/4" plate $b_t = 6"$

$$d_o = 18" \checkmark$$

D stiffener = 64.9" (Section 51) 9" North of Northern Support

$$b_t \geq 2.0 + \frac{D}{30} = 2.0 + \frac{64.9}{30} = 4.16" \text{ OK } b_t = 6"$$

$$16 t_p \geq b_t \geq \frac{b_o}{4} \Rightarrow 16 \times .75 = 12" > 6" > \text{N.A. OK Use } 6"$$

V-33



PROJECT MDOT SS-69801J-P5.3A-Transverse Stiffeners -4
PROJECT # 09D147 DATE 2/11/10 BY jdf SHEET NO. 5/12/10 OF 5

Determine V_u and $\phi_v V_c$

$$V_u = 1.25 \times 226.93 + 1.75 \times 202.3 = 637.7 \text{ k} \leftarrow \text{controls}$$

$$V_u = 1.25 \times 60.9 + 1.75 \times 315.9 = 629.0 \text{ k}$$

$$\phi_v = 1.0$$

$$V_c \Rightarrow \text{per 6.10.9.2} \quad V_c = C V_p$$

$$C \Rightarrow \text{Eq. 6.10.9.3, 2-4 thru -6 w/ } k = 5.0$$

$$\text{tallest } D @ 5\text{ft} = 65.7''$$

$$D/t_w = 65.7 / 0.5 = 131.4 > 1.4 \sqrt{E K_{fyw}}$$

$$\text{Use 6.10.9.3, 2-6}$$

$$C = 1.57 \left(\frac{E K}{(D/t_w)^2} \right) = 0.366$$

$$V_p = 0.58 \times F_{yw} \times D \times t_w = 0.58 \times 36 \times 65.7 \times 0.5 \times 2 = 1371.8 \text{ kip}$$

$$V_c = 0.366 \times 1371.8 = 502.1 \text{ kip}$$

$$V_u > \phi V_c \therefore \text{Use 6.10.11.1, 3-7 or -8}$$

$$I_t = \frac{b d^3}{3} = \frac{18 \times 6^3}{3} = 54 \text{ in}^4$$

$$I_t = b t_w^3 J$$

$$b = d_o = 18''$$

$$D = 64.9''$$

$$t_w = 0.5''$$

$$J = \frac{2.5}{(d_o/D)^2 - 2.0} \geq 0.5 \Rightarrow \frac{2.5}{(18/64.9)^2 - 2.0} = 30.5 > 0.5$$

$$I_t = 18 \times 0.5^3 \times 30.5 = 68.6 \text{ in}^4$$

$$I_{t2} = \frac{D^4 p_k^{1.3}}{40} \left(\frac{F_{yw}}{E} \right)^{1.5}$$

$$p_k = \text{larger of } F_{yw}/F_{cs} \text{ and } 1.0$$

$$F_{cs} = \frac{0.31 E}{(b/t_w)^2} \leq F_{ys} = \frac{0.31 \times 29000}{(6/0.5)^2} = 140.5 < 36$$

$$p_k = 1.0$$

$$\text{Use 36 ksi}$$

$$V-34$$



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PROJECT MnDOT SS-69801J-P5-3A - Transverse Stiffeners -5

PROJECT # 090147 DATE 2/11/10 BY jdf [✓]_{5/12/10} SHEET NO. _____ OF _____

$$I_{t2} = \frac{64.9^4 \times 1.0^{1.3}}{40} \left(\frac{36}{29000} \right)^{1.5} = 19.4 \text{ in}^4 \checkmark$$

Since $I_{t2} \neq I_{t1}$, use 6.10.11.1.3-8 ✓

$$I_t \geq I_{t2} \Rightarrow 54 \text{ in}^4 \geq 19.4 \text{ in}^4 \quad \underline{\text{OK}}$$

Stiffener (E) is OK ✓

All stiffeners are OK
& meet Article 6.10.11.1 requirements.

V-35

CA8013-3A-P5
HL-93 RATING



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(One Lane)

PROJECT MnDOT SS-69801 J-3A.P5. RF Moment @ C $\phi_s = 0.85 \rightarrow 0.95$

PROJECT # 090147 DATE 3/18/10 BY jdf /com 5/12/10 SHEET NO. OF

Determine the Rating Factor at section -C located at the transition of 3/4" to 1 1/2" bottom flange (South side). 18.47' from left.

$$R_n = m_{nc} = 54955 \text{ kip}\cdot\text{in} \quad m_{nt} = 88155 \text{ kip}\cdot\text{in}$$

$$M_{DL} = 1093 \text{ kip}\cdot\text{ft} = 13116 \text{ kip}\cdot\text{in}$$

$$M_{LL+I}(x) = 1233.5 \text{ kip}\cdot\text{ft}$$

$$M_{LL+I}(y) = 34.2 \text{ kip}\cdot\text{ft}$$

$$S_x(\text{comp}) = 2223.25 \text{ in}^3$$

$$S_y = 1104.12 \text{ in}^3$$

$$S_x(\text{ten}) = 2223.25 \text{ in}^3$$

$$RF = \frac{C - \gamma_{DL} \times DL}{\gamma_{LL}(LL+Im)}$$

$$\gamma_{DL} = 1.25$$

$$\gamma_{LL} = 1.35 \text{ oper}, \gamma_{LL} = 1.75 \text{ inv.}$$

Compression Flange will control.

$$C \text{ w/ } \phi_s = 0.85 = 1.0 \times 0.85 \times 1.0 \times 54955 = 46712 \text{ kip}\cdot\text{in}$$

$$C \text{ w/ } \phi_s = 0.95 = 1.0 \times 0.95 \times 1.0 \times 54955 = 52207 \text{ kip}\cdot\text{in}$$

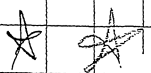
$$LL+Im = m_x + \frac{1}{3} \frac{m_y}{S_y} \times S_{xc} = \left(1233.5 + \frac{1}{3} \times \frac{34.2}{1104.12} \times 2223.25 \right) \times 12 \text{ in}$$

$$= 15077 \text{ kip}\cdot\text{in}$$

$$RF = \frac{46712 - 1.25 \times 13116}{(1.35 \text{ or } 1.75) \times 15077}$$

$$\Rightarrow \begin{matrix} RF_{\text{oper}} = 1.49 \\ RF_{\text{inv}} = 1.15 \end{matrix} \quad \phi_s = 0.85$$

$$\Rightarrow \begin{matrix} RF_{\text{oper}} = 1.76 \\ RF_{\text{inv}} = 1.36 \end{matrix} \quad \phi_s = 0.95$$





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PROJECT MnDOT SS-69801 J-3A P5-RF moment @ C $\phi_s = 0.85$ & 0.95

PROJECT # 090147 DATE 2/5/10 BY jdf / vcm 5/12/10 SHEET NO. OF

Determine the rating factor at section -C located at the transition of $3/4"$ to $1 1/2"$ bottom flange (South Side).

$$R_n = M_{nc} = 54955 \text{ kip}\cdot\text{in} \quad M_{nt} = 88155 \text{ kip}\cdot\text{in}$$

$$M_{DL} = 1093 \text{ kip}\cdot\text{ft} = 13116 \text{ kip}\cdot\text{in}$$

$$M_{LL+I(x)} = 1124 \text{ kip}\cdot\text{ft} = 13488 \text{ kip}\cdot\text{in}$$

$$M_{LL+I(y)} = 56.9 \text{ kip}\cdot\text{ft} = 683 \text{ kip}\cdot\text{in}$$

$$S_x(\text{comp}) = 2223.25 \text{ in}^3 \quad S_x(\text{ten}) = 2223.25 \text{ in}^3$$

$$S_y = 1104.12 \text{ in}^3$$

$$RF = \frac{C - \gamma_{DL} \times DL}{\gamma_{LL} (LL + Im)}$$

$$\gamma_{DL} = 1.25$$

$$\gamma_{LL} = 1.35 \text{ oper}, \gamma_{LL} = 1.75 \text{ inv.}$$

Compression will control

$$C \text{ w/ } \phi_s = 0.85 = 1.0 \times 0.85 \times 1.0 \times 54955 = 46712 \text{ kip}\cdot\text{in}$$

$$C \text{ w/ } \phi_s = 0.95 = 1.0 \times 0.95 \times 1.0 \times 54955 = 52207 \text{ kip}\cdot\text{in}$$

$$LL + Im = m_x + \frac{1}{3} \frac{m_y}{S_y} \times S_x = 13488 + \frac{1}{3} \times \frac{683}{1104.12} \times 2223.25 = 13946 \text{ kip}\cdot\text{in}$$

$$RF_{(85)} = \frac{46712 - 1.25 \times 13116}{(1.35 \text{ or } 1.75) \times 13946}$$

$$\Rightarrow \left. \begin{array}{l} RF_{oper} = 1.61 \\ RF_{inv} = 1.24 \end{array} \right\} \phi_s = 0.85$$

$$\Rightarrow \left. \begin{array}{l} RF_{oper} = 1.90 \\ RF_{inv} = 1.47 \end{array} \right\} \phi_s = 0.95$$



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PROJECT MnDOT SS-69801J - 35. P5. RF moment @ -f, $\phi_s = 0.85 \rightarrow 0.95$

PROJECT # 090147 DATE 3/18/10 BY jdf ^{com} 5/12/10 SHEET NO. _____ OF _____

Determine the rating factor at section -f located at the transition of 3/4" to 1 1/2" bottom flange. (North Side), 10.19' from left.

$$R_n = m_{nc} = 61299 \text{ kip}\cdot\text{in} \quad M_{nt} = 96035 \text{ kip}\cdot\text{in}$$

$$M_{DL} = 1208 \text{ kip}\cdot\text{ft} = 14496 \text{ kip}\cdot\text{in}$$

$$M_{LL+I(x)} = 1295.4 \text{ kip}\cdot\text{ft}$$

$$M_{LL+I(y)} = 34.2 \text{ kip}\cdot\text{ft}$$

$$S_x(\text{comp}) = S_x(\text{ten}) = 2476.95 \text{ in}^3$$

$$S_y = 1172.8 \text{ in}^3$$

$$RF = \frac{C - \gamma_{DL} \times DL}{\gamma_{LL}(LL+Im)}$$

$$\gamma_{DL} = 1.25$$

$$\gamma_{LL} = 1.35 \text{ oper}, \quad \gamma_{LL} = 1.75 \text{ inv.}$$

Compression flange will control

$$C \text{ w/ } \phi_s = 0.85 = 1.0 \times 0.85 \times 1.0 \times 61299 = 52104 \text{ kip}\cdot\text{in}$$

$$C \text{ w/ } \phi_s = 0.95 = 1.0 \times 0.95 \times 1.0 \times 61299 = 58234 \text{ kip}\cdot\text{in}$$

$$LL+Im = M_x + \frac{1}{3} \frac{M_y}{S_y} \times S_{xc} = \left(1295.4 + \frac{1}{3} \frac{34.2}{1172.8} \times 2476.95 \right) 12 \text{ in} = 15834 \text{ kip}\cdot\text{in}$$

$$RF_{(0.85)} = \frac{52104 - 1.25 \times 14496}{(1.35 \text{ or } 1.75) \times 15834} \Rightarrow$$

$$\left. \begin{array}{l} RF_{\text{oper}} = 1.59 \\ RF_{\text{inv}} = 1.23 \end{array} \right\} \phi_s = 0.85$$

$$\Rightarrow \left. \begin{array}{l} RF_{\text{oper}} = 1.88 \\ RF_{\text{inv}} = 1.45 \end{array} \right\} \phi_s = 0.95$$



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PROJECT MnDOT SS-69801 J-3A-P5-RF Moment @ - f $\phi_s = 0.85 \rightarrow 0.95$

PROJECT # 090147 DATE 2/5/10 BY jdf [✓] _{5/12/10} SHEET NO. OF

Determine the rating factor at section - f
located at the transition of 3/4" to 1 1/2" bottom
flange. (North side).

$$R_n = M_{nc} = 61299 \text{ kip}\cdot\text{in} \quad M_{nt} = 96035 \text{ kip}\cdot\text{in}$$

$$M_{DL} = 1208 \text{ kip}\cdot\text{ft} = 14496 \text{ kip}\cdot\text{in} \quad \checkmark$$

$$M_{LL+I(x)} = 1226 \text{ kip}\cdot\text{ft} = 14712 \text{ kip}\cdot\text{in} \quad \checkmark$$

$$M_{LL+I(y)} = 57.1 \text{ kip}\cdot\text{ft} = 685 \text{ kip}\cdot\text{in} \quad \checkmark$$

$$S_{x(\text{comp})} = 2476.95 \text{ in}^3 \quad S_{x(\text{ten})} = 2476.95 \text{ in}^3$$

$$S_y = 1172.8 \text{ in}^3$$

$$RF = \frac{C - \gamma_{DL} \times DL}{\gamma_{LL} (LL + I_m)}$$

$$\gamma_{DL} = 1.25 \quad \checkmark$$

$$\gamma_{LL} = 1.35 \text{ oper.} \quad \checkmark$$

$$\gamma_{LL} = 1.75 \text{ inv.} \quad \checkmark$$

Compression will control.

$$C = \phi_c \phi_s \phi R_n = 1.0 \times 0.85 \times 1.0 \times 61299 = 52104 \text{ kip}\cdot\text{in} \quad \checkmark$$

$$LL + I_m = M_x + \frac{1}{3} \frac{M_y}{S_y} \times S_{xc} = 14712 + \frac{1}{3} \times \frac{685}{1172.8} \times 2476.95 = 15194 \text{ kip}\cdot\text{in}$$

$$RF = \frac{52104 - 1.25 \times 14496}{(1.35 \text{ or } 1.75) \times 15194} = \left. \begin{array}{l} RF_{\text{oper}} = 1.66 \quad \checkmark \\ RF_{\text{inv}} = 1.28 \quad \checkmark \end{array} \right\} \phi_s = 0.85$$

$$C \text{ w/ } \phi_s = 0.95 = 58234 \text{ kip}\cdot\text{in}$$

$$\left. \begin{array}{l} RF_{\text{oper}} = 1.96 \quad \checkmark \\ RF_{\text{inv}} = 1.51 \quad \checkmark \end{array} \right\} \phi_s = 0.95$$



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250 3rd Avenue North, Suite 450
Minneapolis, Minnesota 55401
612 338-2029
Fax 612 338-2088

(one lane).

PROJECT MnDOT SS-6A801J-3A-P5-RF moment @ g $\phi_g = 0.85 \rightarrow 0.95$

PROJECT # 090147 DATE 3/18/10 BY jdf ^{✓ cjm} _{5/12/10} SHEET NO. OF

Although the $m_x @ g$ is larger than two lanes
the m_y is less.

$$LL + Im = m_x + \frac{1}{3} \frac{m_y}{s_y} \times S_x$$
$$= (1572.9 + \frac{1}{3} \times \frac{45.329}{31.7} \times 3773.15) \times 12 = 19395 \text{ kip}\cdot\text{in}$$

which is less than the 2 lane case.

2 lanes control @ g



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(two lane)

PROJECT MnDOT SS-69801 J-3A-P5 - RF Moment @ -g $\phi_s = 0.85$

PROJECT # 090147 DATE 2/5/10 BY jdf SHEET NO. OF

✓
CJM
5/2/10

Determine the rating factor at section -g
located at point of maximum moment

$$R_n = M_{nc} = 126255 \text{ kip}\cdot\text{in} \quad M_{nt} = 125033 \text{ kip}\cdot\text{in}$$

$$M_{DL} = 1562.14 \text{ kip}\cdot\text{ft} = 18746 \text{ kip}\cdot\text{in} \quad \checkmark$$

$$M_{LL+I(x)} = 1581.89 \text{ kip}\cdot\text{ft} = 18983 \text{ kip}\cdot\text{in} \quad \checkmark$$

$$M_{LL+I(y)} = 75.55 \text{ kip}\cdot\text{ft} = 907 \text{ kip}\cdot\text{in} \quad \checkmark$$

$$S_x(\text{comp}) = 3773.13 \text{ in}^3 \quad S_x(\text{ten}) = 2652.65 \text{ in}^3$$

$$S_y = 1317 \text{ in}^3 \quad \checkmark$$

$$RF = \frac{C - \gamma_{DL} \times DL}{\gamma_{LL} (LL + Im)}$$

$$\gamma_{DL} = 1.25 \quad \checkmark$$

$$\gamma_{LL} = 1.35 \text{ oper} \quad \checkmark$$

$$\gamma_{LL} = 1.75 \text{ inv.} \quad \checkmark$$

Compression Flange RF

$$C = \phi_c \phi_s \phi R_n = 1.0 \times 0.85 \times 1.0 \times 126255 = 107317 \text{ kip}\cdot\text{in} \quad \checkmark$$

$$LL + Im = m_x + \frac{1}{3} \frac{m_y}{S_y} \times S_{xc} = 18983 + \frac{1}{3} \times \frac{907}{1317} \times 3773.13 = 19849 \text{ kip}\cdot\text{in} \quad \checkmark$$

$$RF_c = \frac{107317 - 1.25 \times 18746}{(1.35 \text{ or } 1.75)(19849)} \Rightarrow$$

$$RF_{oper} = 3.13 \quad \checkmark$$

$$RF_{inv} = 2.41 \quad \checkmark$$

Tension Flange RF

$$C = \phi_c \phi_s \phi R_n = 1.0 \times 0.85 \times 1.0 \times 125033 = 106278 \text{ kip}\cdot\text{in} \quad \checkmark$$

$$LL + Im = m_x + \frac{1}{3} \frac{m_y}{S_y} \times S_{xt} = 18983 + \frac{1}{3} \times \frac{907}{1317} \times 2652 = 19592 \text{ kip}\cdot\text{in} \quad \checkmark$$

$$RF_t = \frac{106278 - 1.25 \times 18746}{(1.35 \text{ or } 1.75)(19592)} \Rightarrow$$

$$RF_{oper} = 3.13 \quad \checkmark$$

$$RF_{inv} = 2.42 \quad \checkmark$$

W-6



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PROJECT MnDOT SS-69801 J-3A-P5 - RF Moment @ -g $\phi_s = 0.85$
PROJECT # 090147 DATE 2/5/10 BY jdf SHEET NO. 1/3 OF 3
5/12/10

Determine the rating factor at section -g
located at point of maximum moment

$$R_n = M_{nc} = 126255 \text{ kip}\cdot\text{in} \quad M_{nt} = 125033 \text{ kip}\cdot\text{in}$$

$$\begin{aligned} M_{DL} &= 1562.14 \text{ kip}\cdot\text{ft} = 18746 \text{ kip}\cdot\text{in} \checkmark \\ M_{LL+I(x)} &= 1581.89 \text{ kip}\cdot\text{ft} = 18983 \text{ kip}\cdot\text{in} \checkmark \\ M_{LL+I(y)} &= 75.55 \text{ kip}\cdot\text{ft} = 907 \text{ kip}\cdot\text{in} \checkmark \\ S_x(\text{comp}) &= 3773.13 \text{ in}^3 \quad S_x(\text{ten}) = 2652.65 \text{ in}^3 \checkmark \\ S_y &= 1317 \text{ in}^3 \end{aligned}$$

$$RF = \frac{C - \gamma_{DL} \times DL}{\gamma_{LL} (LL + Im)} \quad \gamma_{DL} = 1.25 \quad \gamma_{LL} = 1.35 \text{ oper} \quad \gamma_{LL} = 1.75 \text{ inv.}$$

Compression Flange RF_{95}

$$\begin{aligned} C &= \phi_c \phi_s \phi R_n = 1.0 \times 0.85 \times 1.0 \times 126255 = 107317 \text{ kip}\cdot\text{in} \checkmark \\ LL + Im &= m_x + \frac{1}{3} \frac{m_y}{S_y} \times S_{xc} = 18983 + \frac{1}{3} \times \frac{907}{1317} \times 3773.13 = 19849 \text{ kip}\cdot\text{in} \checkmark \\ RF_c &= \frac{107317 - 1.25 \times 18746}{(1.35 \times 1.75)(19849)} \Rightarrow RF_{oper} = 3.13 \quad 3.60 \checkmark \\ &\quad RF_{inv} = 2.41 \quad 2.78 \checkmark \end{aligned}$$

Tension Flange RF_{95}

$$\begin{aligned} C &= \phi_c \phi_s \phi R_n = 1.0 \times 0.85 \times 1.0 \times 125033 = 106278 \text{ kip}\cdot\text{in} \checkmark \\ LL + Im &= m_x + \frac{1}{3} \frac{m_y}{S_y} \times S_{xt} = 18983 + \frac{1}{3} \times \frac{907}{1317} \times 2652 = 19592 \text{ kip}\cdot\text{in} \checkmark \\ RF_t &= \frac{106278 - 1.25 \times 18746}{(1.35 \text{ or } 1.75)(19592)} \Rightarrow RF_{oper} = 3.13 \quad 3.60 \checkmark \\ &\quad RF_{inv} = 2.42 \quad 2.78 \checkmark \end{aligned}$$



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PROJECT Mn DOT SS-69801J-3A.P5.RF Shear - one lane - 1

PROJECT # 090147 DATE 3/18/10 BY jdf SHEET NO. _____ OF _____

✓CSM
5/12/10

RF for between (A+B) & (E+F)

$$R_n = 689.0 \text{ k} \checkmark$$

$$V_{DL} = 100.9 \text{ k} \checkmark$$

$$V_{LL+Im} = 118.2 \text{ k} \checkmark$$

$$RF = \frac{1.0^3 \times 689 - 1.25 \times 100.9}{(1.35 \text{ or } 1.75) \times 118.2 \text{ k}} \Rightarrow \begin{aligned} \text{oper} &= 3.53 \checkmark \\ \text{inv} &= 2.72 \checkmark \end{aligned}$$

RF for between B & North Support & South Support & E

$$R_n = 1197.0 \text{ k} \checkmark$$

$$V_{DL} = 226.9 \text{ k} \checkmark$$

$$V_{LL+Im} = 183.8 \text{ k} \checkmark$$

← will not control
2 lanes will control.

RF for between the North & South Supports.

$$R_n = 1289.0 \text{ k} \checkmark$$

$$V_{DL} = 74.8 \text{ k} \checkmark$$

$$V_{LL+Im} = 315.9 \text{ k} \checkmark$$

$$RF = \frac{1.0^3 \times 1289.0 - 1.25 \times 74.8}{(1.35 \text{ or } 1.75) \times 315.9 \text{ k}} \Rightarrow \begin{aligned} \text{oper} &= 2.80 \checkmark \\ \text{inv} &= 2.16 \checkmark \end{aligned}$$

W-8
★



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PROJECT Mn DOT SS-69801 J-3A.P5. RF Shear - two lanes -1

PROJECT # 090147 DATE 2/10/10 BY jdf SHEET NO. 1 OF 1

✓ cjm
5/12/10

RF for between A+B + E+F

$$R_n = 689.0 \text{ k} \checkmark$$

$$V_{DL} = 100.9 \text{ k} \checkmark$$

$$V_{LL+Im} = 103.3 \text{ k} \checkmark$$

$$RF_{oper} = \frac{1.0^3 \times 689 - 1.25 \times 100.9}{1.35 \times 103.3} = 4.04 \checkmark$$

$$RF_{inv} = \frac{1.0^3 \times 689 - 1.25 \times 100.9}{1.75 \times 103.3} = 3.11 \checkmark$$

RF for between B+N support and South Support + E

$$R_n = 1197 \text{ k} \checkmark$$

$$V_{DL} = 226.93 \text{ k} \checkmark$$

$$V_{LL+Im} = 202.4 \text{ k} \checkmark$$

$$RF_{oper} = \frac{1.0^3 \times 1197 - 1.25 \times 226.93}{1.35 \times 202.4} = 3.34 \checkmark$$

$$RF_{inv} = \frac{1.0^3 \times 1197 - 1.25 \times 226.93}{1.75 \times 202.4} = 2.58 \checkmark$$

RF for between N support and South Support

$$R_n = 1289.0 \text{ k} \checkmark$$

$$V_{DL} = 60.9 \text{ k} \checkmark$$

$$V_{LL+Im} = 311.5 \text{ k} \checkmark$$

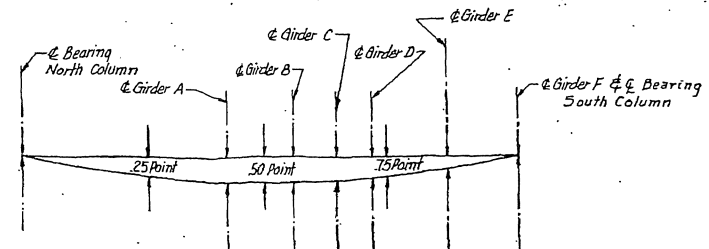
$$RF_{oper} = \frac{1.0^3 \times 1289 - 1.25 \times 60.9}{(1.35 \text{ or } 1.75) \times 311.5} \Rightarrow \begin{matrix} oper = 2.88 \checkmark \\ inv = 2.22 \checkmark \end{matrix}$$

W-9

648015-3A-95
SUMMARY

FINAL RATING SUMMARY TABLE FOR PIER 69801J P5-3A (LRFR method, System factor $\phi_s = 0.85$)						COMPLETED BY: JDF	CHECKED BY: CJM
						DATE: 6-11-10	DATE: 6/25/10
	TRUCK	MULTIPLE-TRIP		SINGLE-TRIP		COMMENTS	
		RF	LOCATION	RF	LOCATION		
AASHTO	HL-93 INV	1.15	N bottom flange transition	N/A	N/A	Flexure Controls	
	HL-93 OP	1.49	N bottom flange transition	N/A	N/A	Flexure Controls	
Posting Vehicles*	Type 3 +SU7	N/A	N/A	N/A	N/A	N/A	
	Type 3S2-40 + SU7	N/A	N/A	N/A	N/A	N/A	
	Type 3S3 + SU7	N/A	N/A	N/A	N/A	N/A	
Permit Vehicles* (Mix with traffic)	STD. A + SU7	N/A	N/A	N/A	N/A	N/A	
	STD. B + SU7	N/A	N/A	N/A	N/A	N/A	
	STD. C + SU7	N/A	N/A	N/A	N/A	N/A	
	P411 + SU7	N/A	N/A	N/A	N/A	N/A	
	P413 + SU7	N/A	N/A	N/A	N/A	N/A	
	C152b + SU7	N/A	N/A	N/A	N/A	N/A	
	C174b + SU7	N/A	N/A	N/A	N/A	N/A	
	C198_23 + SU7	N/A	N/A	N/A	N/A	N/A	
	C214b + SU7	N/A	N/A	N/A	N/A	N/A	
	C237b + SU7	N/A	N/A	N/A	N/A	N/A	
	C256b + SU7	N/A	N/A	N/A	N/A	N/A	
Permit Vehicles* (Escorted with no other vehicles)	C200j + SU7	N/A	N/A	N/A	N/A	N/A	
	STD. A	N/A	N/A	N/A	N/A	N/A	
	STD. B	N/A	N/A	N/A	N/A	N/A	
	STD. C	N/A	N/A	N/A	N/A	N/A	
	P411	N/A	N/A	N/A	N/A	N/A	
	P413	N/A	N/A	N/A	N/A	N/A	
	C152b	N/A	N/A	N/A	N/A	N/A	
	C174b	N/A	N/A	N/A	N/A	N/A	
	C198_23	N/A	N/A	N/A	N/A	N/A	
	C214b	N/A	N/A	N/A	N/A	N/A	
	C237b	N/A	N/A	N/A	N/A	N/A	
	C256b	N/A	N/A	N/A	N/A	N/A	
	C200j	N/A	N/A	N/A	N/A	N/A	

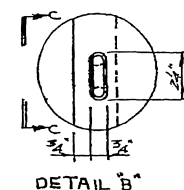
* Posting and Permit Vehicle ratings were not completed due to satisfactory HL-93 results.



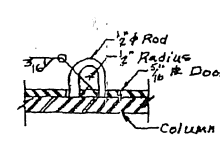
PLAN
Scale: $\frac{1}{4}'' = 1' - 0''$

Deflection									
N. Brq.	.25 Pt.	Girder A	.50 Pt.	Girder B	Girder C	Girder D	.75 Pt.	Girder E	Girder F S. Brq.
0	$\frac{3}{8}$ "	$\frac{1}{2}$ "	$\frac{1}{2}$ "	$\frac{1}{2}$ "	$\frac{1}{2}$ "	$\frac{7}{16}$ "	$\frac{3}{8}$ "	$\frac{1}{4}$ "	0

DEAD LOAD DEFLECTION DIAGRAM
No Scale



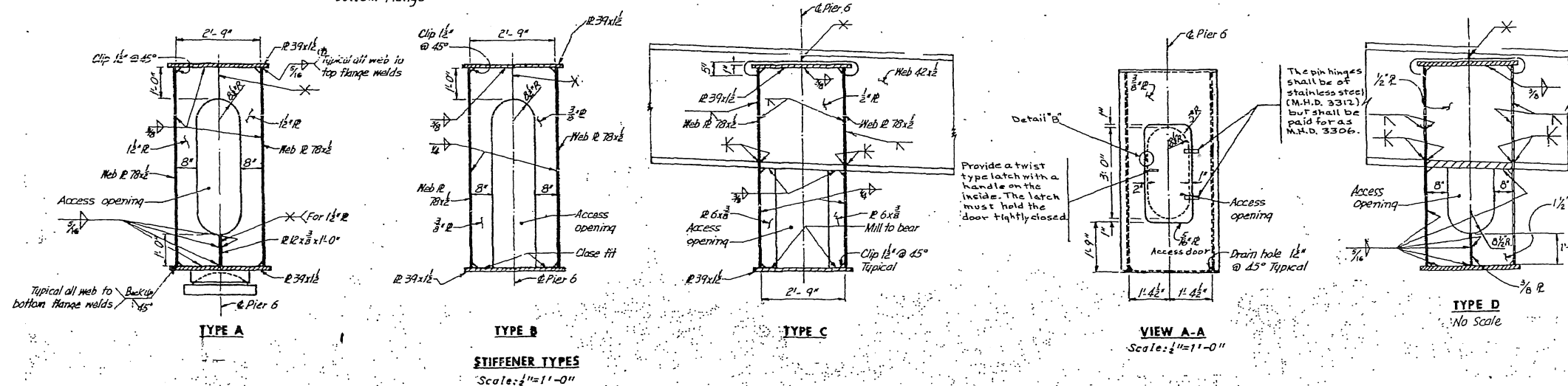
DETAIL "B"



SECTION C-C

Notes:

- For details of materials and finish not shown on shoes see Bearing Assembly Details.
- For details of girder and beam sections not shown see Framing Plans.
- Prior to placement of the deck concrete the entire area of the cap beam will be in contact with the concrete shoes and covered with a protective coating similar or equal to Koppers Company Bitumastic 50.
- The deck slab shall be haunched to the top of the cap beam.
- The cap beam shall be cambered for dead load deflection.
- Anchor bolts shall be held in position during concreting by a 1/2" steel template.



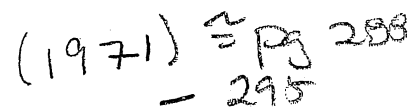
H.N.T.B. BR. NO. 2A, 2C-2K, 3A-3E

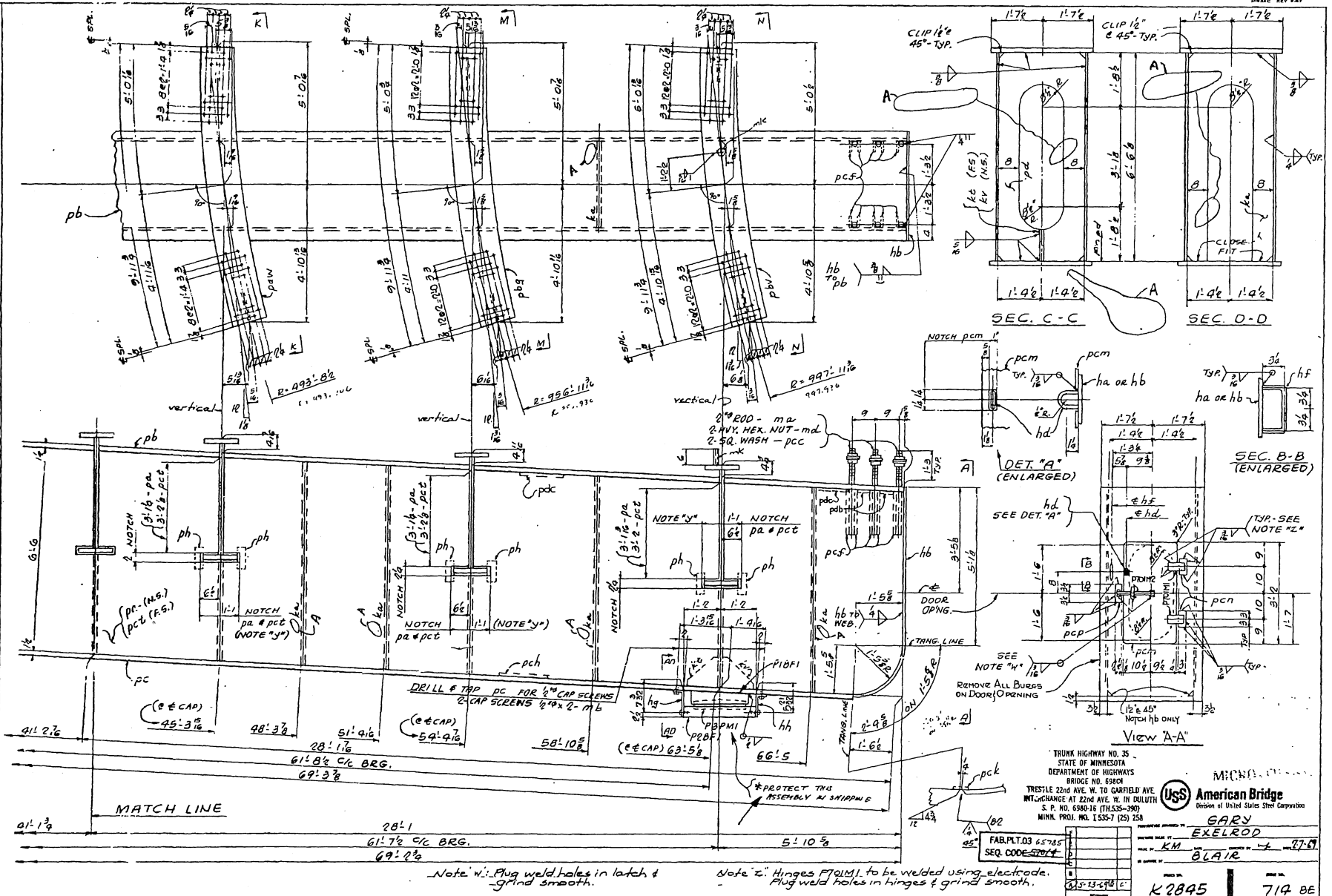
TRUNK HIGHWAY NO. 35
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS
INTERSTATE ROUTES IN DULUTH
BRIDGE NO. 69801

STEEL CAP BEAM DETAILS
PIER 6 BRIDGE 3A

MICRO - FILMED

APPROVED: 7-30-68





Note "w": Plug weld holes in latch & grind smooth.

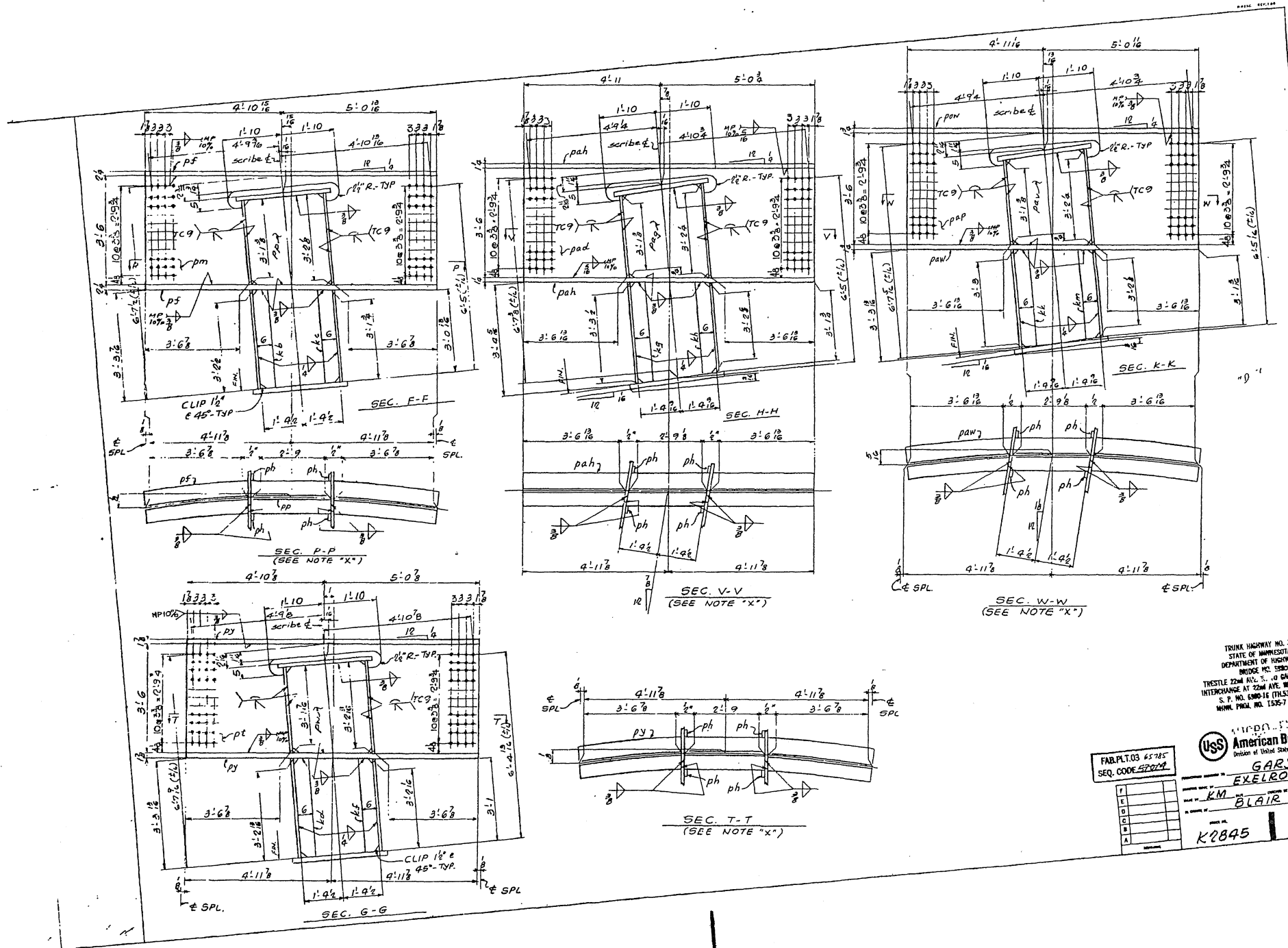
Note "z": Hinges F70M1 to be welded using electrode. Plug weld holes in hinges & grind smooth.

TRUNK HIGHWAY NO. 35
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS
BRIDGE NO. 6900
TRESTLE 2200 AVE. W. TO GARFIELD AVE.
INT. CHANGE AT 2200 AVE. W. IN ENCLUTH
S. P. NO. 6900-16 (THS35-390)
MINN. PROJ. NO. 1535-7 (25) 258

MINN. American Bridge
Division of United States Steel Corporation

FAB. PLT. 03 65785	SEQU. CODE 5704	DESIGNED BY	BLAIR	DATE	7/7/79
K2845		714 BE			

4-4



TRUNK HIGHWAY NO. 35
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS
BRIDGE NO. 55801
THREESTLE 22nd AVE. S. & 4th STREET AVE. IN DULUTH
INTERCHANGE AT 22nd AVE. S. & 4th STREET AVE.
S. P. NO. 1580-16 (PLS. 55-300)
MINN. PROJ. NO. 1535-7 (25) 258

U.S.S. American Bridge
Division of United States Steel Corporation

FAB. PLT. 03 65785
SEQ. CODE 57074

1	
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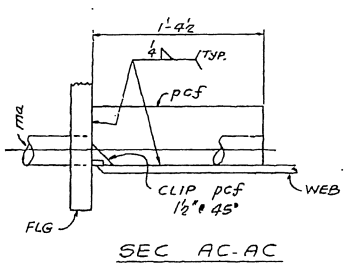
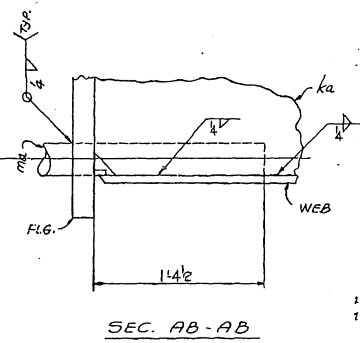
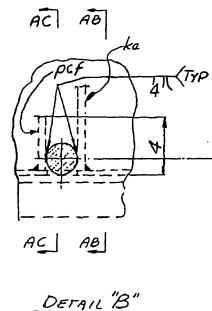
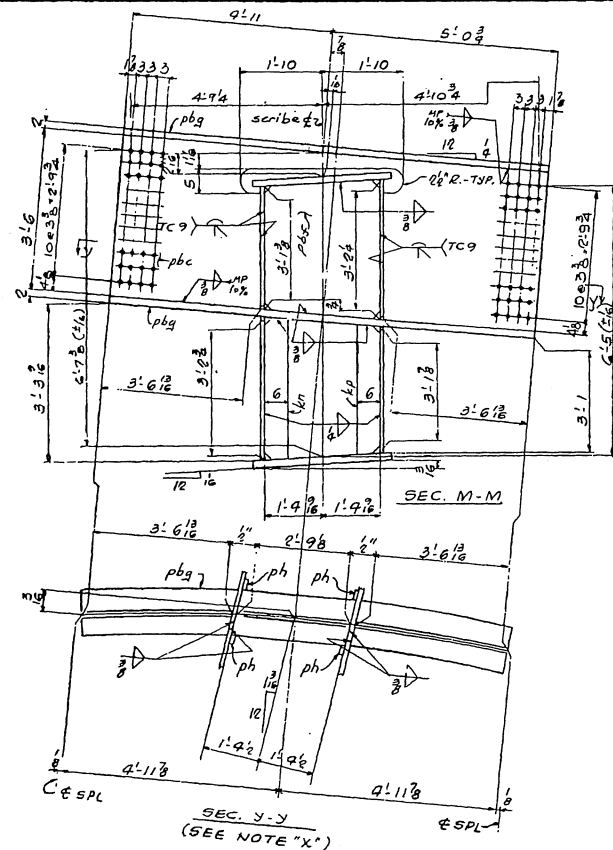
DESIGNED BY
GARY EXELROD
CHECKED BY
KM BLAIR
DATE
K2845
714CE

SECTION 2-20 BRIDGE NO. 100, TOL. BRIDGE EAST

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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Check roof before
installing floor.
Check floor before
installing roof.
Check floor before
installing roof.
Check floor before
installing roof.



ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	TOTAL	REMARKS
1	PL 3/8" x 12"	1	sq ft	1.00	1.00	
2	PL 3/8" x 12"	1	sq ft	1.00	1.00	
3	PL 3/8" x 12"	1	sq ft	1.00	1.00	
4	PL 3/8" x 12"	1	sq ft	1.00	1.00	
5	PL 3/8" x 12"	1	sq ft	1.00	1.00	
6	PL 3/8" x 12"	1	sq ft	1.00	1.00	
7	PL 3/8" x 12"	1	sq ft	1.00	1.00	
8	PL 3/8" x 12"	1	sq ft	1.00	1.00	
9	PL 3/8" x 12"	1	sq ft	1.00	1.00	
10	PL 3/8" x 12"	1	sq ft	1.00	1.00	
11	PL 3/8" x 12"	1	sq ft	1.00	1.00	
12	PL 3/8" x 12"	1	sq ft	1.00	1.00	
13	PL 3/8" x 12"	1	sq ft	1.00	1.00	
14	PL 3/8" x 12"	1	sq ft	1.00	1.00	
15	PL 3/8" x 12"	1	sq ft	1.00	1.00	
16	PL 3/8" x 12"	1	sq ft	1.00	1.00	
17	PL 3/8" x 12"	1	sq ft	1.00	1.00	
18	PL 3/8" x 12"	1	sq ft	1.00	1.00	
19	PL 3/8" x 12"	1	sq ft	1.00	1.00	
20	PL 3/8" x 12"	1	sq ft	1.00	1.00	
21	PL 3/8" x 12"	1	sq ft	1.00	1.00	
22	PL 3/8" x 12"	1	sq ft	1.00	1.00	
23	PL 3/8" x 12"	1	sq ft	1.00	1.00	
24	PL 3/8" x 12"	1	sq ft	1.00	1.00	
25	PL 3/8" x 12"	1	sq ft	1.00	1.00	
26	PL 3/8" x 12"	1	sq ft	1.00	1.00	
27	PL 3/8" x 12"	1	sq ft	1.00	1.00	
28	PL 3/8" x 12"	1	sq ft	1.00	1.00	
29	PL 3/8" x 12"	1	sq ft	1.00	1.00	
30	PL 3/8" x 12"	1	sq ft	1.00	1.00	
31	PL 3/8" x 12"	1	sq ft	1.00	1.00	
32	PL 3/8" x 12"	1	sq ft	1.00	1.00	
33	PL 3/8" x 12"	1	sq ft	1.00	1.00	
34	PL 3/8" x 12"	1	sq ft	1.00	1.00	
35	PL 3/8" x 12"	1	sq ft	1.00	1.00	
36	PL 3/8" x 12"	1	sq ft	1.00	1.00	
37	PL 3/8" x 12"	1	sq ft	1.00	1.00	
38	PL 3/8" x 12"	1	sq ft	1.00	1.00	
39	PL 3/8" x 12"	1	sq ft	1.00	1.00	
40	PL 3/8" x 12"	1	sq ft	1.00	1.00	
41	PL 3/8" x 12"	1	sq ft	1.00	1.00	
42	PL 3/8" x 12"	1	sq ft	1.00	1.00	
43	PL 3/8" x 12"	1	sq ft	1.00	1.00	
44	PL 3/8" x 12"	1	sq ft	1.00	1.00	
45	PL 3/8" x 12"	1	sq ft	1.00	1.00	
46	PL 3/8" x 12"	1	sq ft	1.00	1.00	
47	PL 3/8" x 12"	1	sq ft	1.00	1.00	
48	PL 3/8" x 12"	1	sq ft	1.00	1.00	
49	PL 3/8" x 12"	1	sq ft	1.00	1.00	
50	PL 3/8" x 12"	1	sq ft	1.00	1.00	
51	PL 3/8" x 12"	1	sq ft	1.00	1.00	
52	PL 3/8" x 12"	1	sq ft	1.00	1.00	
53	PL 3/8" x 12"	1	sq ft	1.00	1.00	
54	PL 3/8" x 12"	1	sq ft	1.00	1.00	
55	PL 3/8" x 12"	1	sq ft	1.00	1.00	
56	PL 3/8" x 12"	1	sq ft	1.00	1.00	
57	PL 3/8" x 12"	1	sq ft	1.00	1.00	
58	PL 3/8" x 12"	1	sq ft	1.00	1.00	
59	PL 3/8" x 12"	1	sq ft	1.00	1.00	
60	PL 3/8" x 12"	1	sq ft	1.00	1.00	
61	PL 3/8" x 12"	1	sq ft	1.00	1.00	
62	PL 3/8" x 12"	1	sq ft	1.00	1.00	
63	PL 3/8" x 12"	1	sq ft	1.00	1.00	
64	PL 3/8" x 12"	1	sq ft	1.00	1.00	
65	PL 3/8" x 12"	1	sq ft	1.00	1.00	
66	PL 3/8" x 12"	1	sq ft	1.00	1.00	
67	PL 3/8" x 12"	1	sq ft	1.00	1.00	
68	PL 3/8" x 12"	1	sq ft	1.00	1.00	
69	PL 3/8" x 12"	1	sq ft	1.00	1.00	
70	PL 3/8" x 12"	1	sq ft	1.00	1.00	
71	PL 3/8" x 12"	1	sq ft	1.00	1.00	
72	PL 3/8" x 12"	1	sq ft	1.00	1.00	
73	PL 3/8" x 12"	1	sq ft	1.00	1.00	
74	PL 3/8" x 12"	1	sq ft	1.00	1.00	
75	PL 3/8" x 12"	1	sq ft	1.00	1.00	
76	PL 3/8" x 12"	1	sq ft	1.00	1.00	
77	PL 3/8" x 12"	1	sq ft	1.00	1.00	
78	PL 3/8" x 12"	1	sq ft	1.00	1.00	
79	PL 3/8" x 12"	1	sq ft	1.00	1.00	
80	PL 3/8" x 12"	1	sq ft	1.00	1.00	
81	PL 3/8" x 12"	1	sq ft	1.00	1.00	
82	PL 3/8" x 12"	1	sq ft	1.00	1.00	
83	PL 3/8" x 12"	1	sq ft	1.00	1.00	
84	PL 3/8" x 12"	1	sq ft	1.00	1.00	
85	PL 3/8" x 12"	1	sq ft	1.00	1.00	
86	PL 3/8" x 12"	1	sq ft	1.00	1.00	
87	PL 3/8" x 12"	1	sq ft	1.00	1.00	
88	PL 3/8" x 12"	1	sq ft	1.00	1.00	
89	PL 3/8" x 12"	1	sq ft	1.00	1.00	
90	PL 3/8" x 12"	1	sq ft	1.00	1.00	
91	PL 3/8" x 12"	1	sq ft	1.00	1.00	
92	PL 3/8" x 12"	1	sq ft	1.00	1.00	
93	PL 3/8" x 12"	1	sq ft	1.00	1.00	
94	PL 3/8" x 12"	1	sq ft	1.00	1.00	
95	PL 3/8" x 12"	1	sq ft	1.00	1.00	
96	PL 3/8" x 12"	1	sq ft	1.00	1.00	
97	PL 3/8" x 12"	1	sq ft	1.00	1.00	
98	PL 3/8" x 12"	1	sq ft	1.00	1.00	
99	PL 3/8" x 12"	1	sq ft	1.00	1.00	
100	PL 3/8" x 12"	1	sq ft	1.00	1.00	

701 K2845 714 DE

TRUNK HIGHWAY NO. 35
STATE OF MINNESOTA
DEPARTMENT OF HIGHWAYS
BRIDGE NO. 698-01
TRESTLE 22nd AVE. W. TO GARFIELD AVE.
INTERCHANGE AT 22nd AVE. W. IN DULUTH
S. P. NO. 698-01 (PL 55-390)
MINN. PROJ. NO. 1335-7 (23) 258

U.S.S. American Bridge
Division of United States Steel Corporation
GARY EXELROD
BLAIR

4.5



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PB-3A

PROJECT Mn DOT SS-69801 J - Controlling Load Combination

PROJECT # 090147 DATE 1/19/10 BY jdf

SHEET NO. OF

✓cm
5/11/10

Design Pier Cap Loading for

- ① 2 lanes of lane + truck loading
- ② 2 lanes of lane + tandem loading
- ③ 2 lanes of 0.9 lane + 0.9 (2 truck @ 50')

Reactions due to

" " "
" " "
" " "

Lane =

65.3 k ✓

Truck =

70.6 k ✓

Tandem =

50.0 k ✓

2 trucks @ 50' =

98.0 k ✓

change of
minority
due to Ixx
Revisions
New Loads
not interpreted.

What will control?

Impact factor is $1 + \frac{33}{100} = 1.33$ ✓ to
truck or tandem loads only (not lane)

Reaction per lane:

① $65.3 + 1.33 \times 70.6 = 159.2 \text{ k}$ ✓

② $65.3 + 1.33 \times 50.0 = 131.8 \text{ k}$ ✓

③ $0.9 \times 65.3 + 0.9 \times 1.33 \times 98.0 = 176.1 \text{ k}$ ✓ ← controls

0.9 Lane + 0.9 (2 truck @ 50') controls ✓

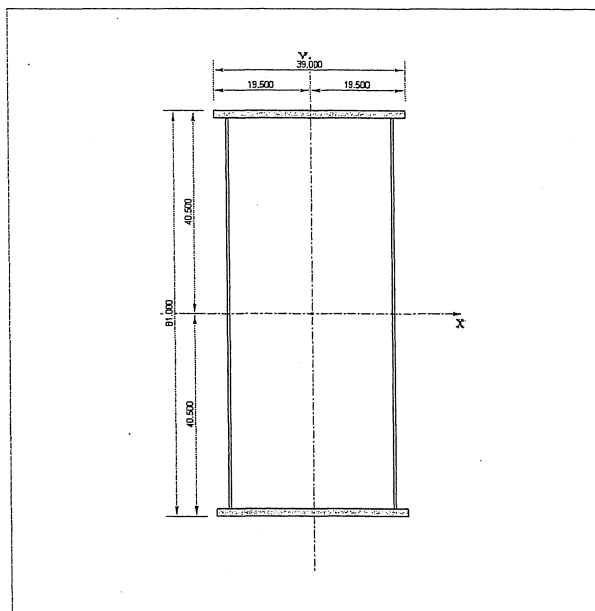
5/6/10

Section Properties: BR3A-P6-1

Number of Shapes	=	4	
Total Width	=	39.000	in
Total Height	=	81.000	in
Center, Xo	=	0.000	in
Center, Yo	=	0.000	in
X-bar(Right)	=	19.500	in
X-bar(Left)	=	19.500	in
Y-bar(Top)	=	40.500	in
Y-bar(Bot)	=	40.500	in

Equivalent Properties:

Area, Ax	=	195.00	in^2
Inertia, Ixx	=	2.244E+005	in^4
Inertia, Iyy	=	3.672E+004	in^4
Inertia, Ixy	=	0.000	in^4
Modulus, Sx(Top)	=	5541.61	in^3
Modulus, Sx(Bot)	=	5541.61	in^3
Modulus, Sy(Left)	=	1882.83	in^3
Modulus, Sy(Right)	=	1882.83	in^3
Radius, rx	=	33.926	in
Radius, ry	=	13.722	in
Plastic Modulus, Zx	=	6171.75	in^3
Plastic Modulus, Zy	=	2447.25	in^3
Torsional, J	=	92.610	in^4



Section Diagram

4-8

Company : LHB
 Designer : jdf
 Job Number: 090147

Nov 12, 2009
 14:54 PM
 Checked By: CSM

5/6/10

Basic Properties of Shapes in Section: BR3A-P6-1 (Local Axis, for n=1)

Sh.No.	1	2	3	4
Shape	Top Flange	Bottom Flange	Left Web	Right Web
Ratio(n)	1.000	1.000	1.000	1.000
Width (in)	39.000	39.000	0.500	0.500
Height (in)	1.500	1.500	78.000	78.000
Xo (in)	0.000	0.000	-16.750	16.750
Yo (in)	39.750	-39.750	0.000	0.000
Ax (in^2)	58.500	58.500	39.000	39.000
Ixx (in^4)	10.969	10.969	1.977E+004	1.977E+004
Iyy (in^4)	7414.88	7414.88	0.813	0.813

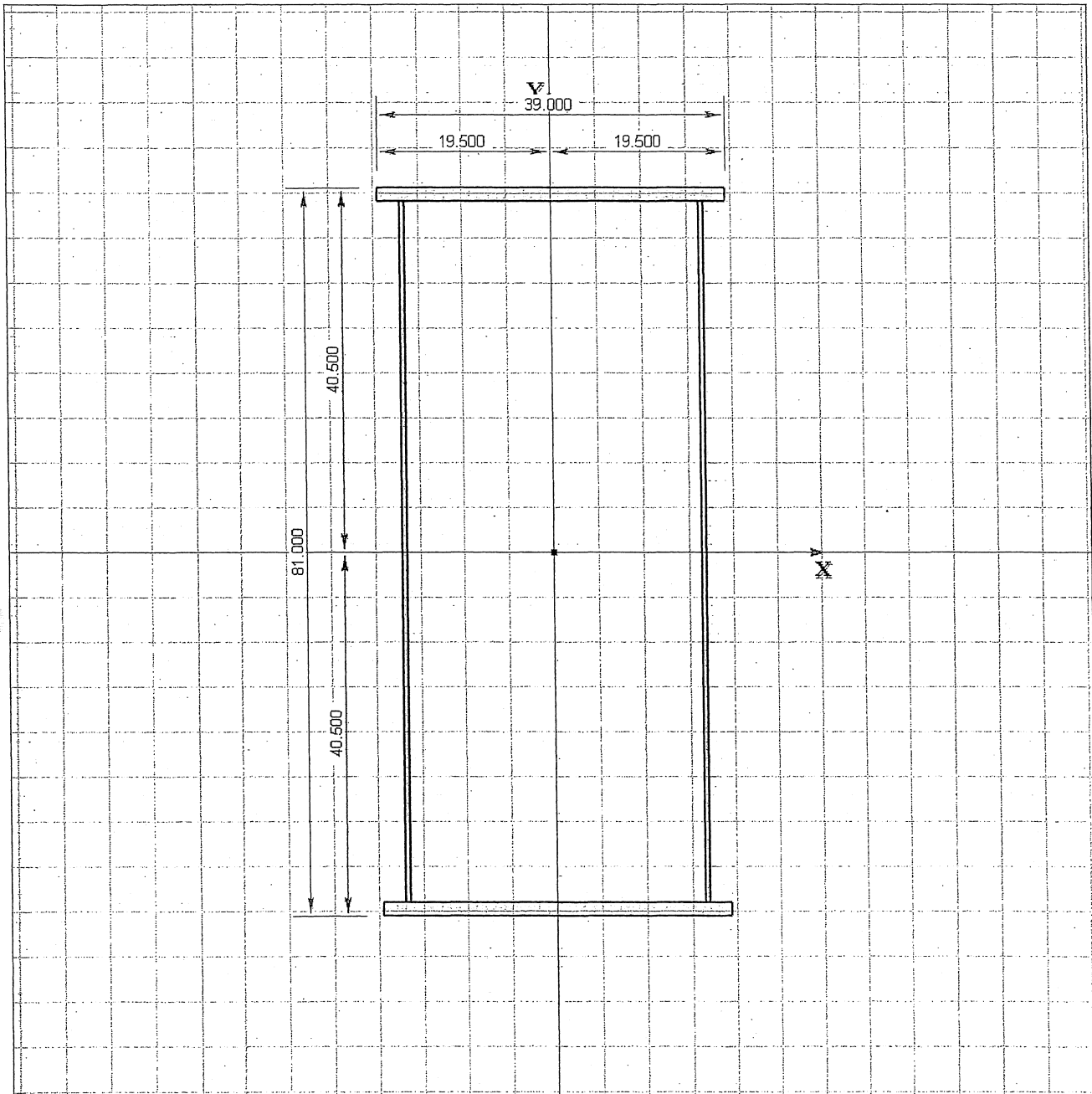
Additional Properties of Shapes in Section: BR3A-P6-1 (Local Axis, for n=1)

Sx-Top (in^3)	14.625	14.625	507.00	507.00
Sy-Right (in^3)	380.25	380.25	3.250	3.250
rx (in)	0.433	0.433	22.517	22.517
ry (in)	11.258	11.258	0.144	0.144
Zx (in^3)	21.938	21.938	760.50	760.50
Zy (in^3)	570.38	570.38	4.875	4.875
J (in^4)	5.024	0.000E+000	3.247	0.000E+000

4-9

5/6/10

Section view: BR3A-P6-1



V-10



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PROJECT Mn DOT SS-69801 3A-P6, Pinned or Fixed
PROJECT # 090147 DATE 11/10/09 BY jdf SHEET NO. 1 OF 1

✓
CSM
5/10/10

Are the beam to pier cap and pier cap to pier connections fixed, pinned, or partially restrained?

Beam design calcs show typical continuous beam with pinned supports. ✓

Beam to pier cap connections are made at web and bottom flange only. ✓

Pier cap design does not consider any torsion nor is there special detailing in the longitudinal direction. ✓



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PROJECT Mn DOT - BR69801 3A-P6 - Cap Beam Self wt.
PROJECT # 090147 DATE 11/24/09 BY jdf [✓] 5/6/10 SHEET NO. OF

Determine the Cap Beam's Self wt

Area of box girder = 195 in^2 (See Risa Section).

Typical stiffener is $\frac{3}{8}"$ plate $\times 2'-9" \times 78"$
minus $1'-5" \times 64"$ @ $\approx 3' \text{ o.c.}$

^{approx}
Stiffener wt = $\frac{3}{8} \times (2.75 \times 6.5 - 1.42 \times 5.33) \div 12 \times 490 \text{ pcf}$
= 158 lb

$158 \text{ lb} @ 3'-0" \text{ o.c.} \rightarrow 53 \text{ plf}$

Beam wt = $195 \text{ in}^2 \div (12 \text{ in})^2 \times 490 \text{ pcf} \div 3 + 53 = 716.5 \text{ plf}$

Use 10% more for other plates and fasteners: $716.5 \times 1.1 = 788 \text{ plf}$

Use 788 plf



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PROJECT MnDOT SS-69801 J - PL6-3A - Sign bridge wt -1
PROJECT # 090147 DATE 12/15/09 BY jdf SHEET NO. _____ OF _____
5/6/10

Bridge Span = $46.6'$ = L

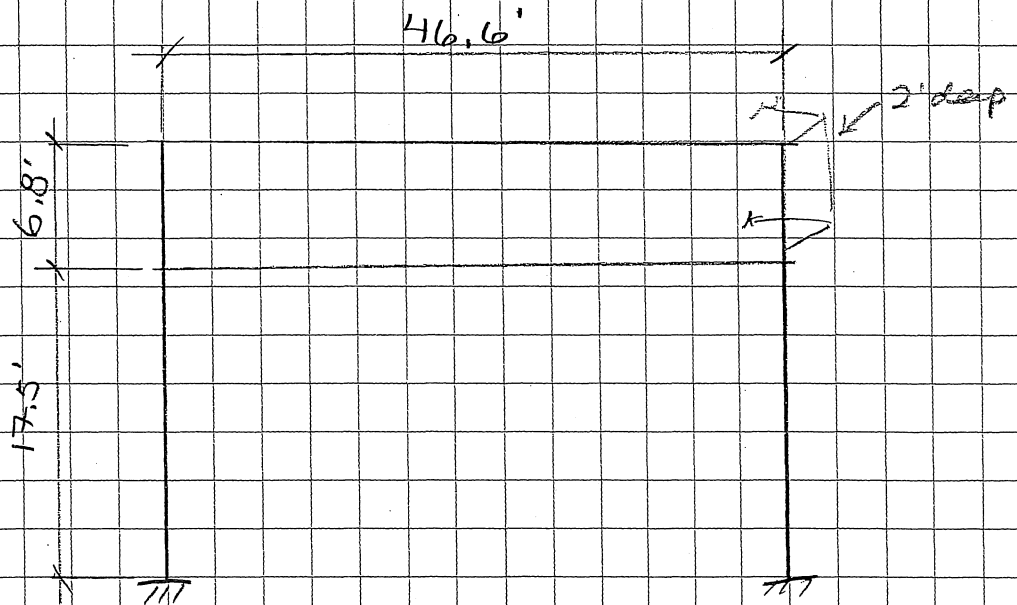
Full beam cap length = $69'-3\frac{1}{2}"$ ✓
in photo it is $8.7"$ long ✓

in photo Sign bridge "H" = $2.2"$ long ✓
" in real life = $17.5'$ tall ✓

in photo Sign bridge "S" is = $.85"$ long ✓
" in real life = $6.8'$ ✓

Sign area = $7' \times 40' = 280 \text{ ft}^2$ ✓

Plan on $L 4 \times 4 \times \frac{3}{8}"$ chord angles,
 $L 2 \times 2 \times \frac{1}{4}"$ web angles, (vertical & plan)
HSS $10 \times$ Extra strong pipe columns.





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PROJECT MnDOT SS-69801 J - Pb-3A - Sign Bridge wt -2
PROJECT # 090147 DATE 12/15/09 BY jdf SHEET NO. 1/5 OF 110

Continuous along Bridge: (46.6' long)

$$\begin{aligned} (4) L4 \times 4 \times 3/8 &= 4 \times 9.8 \text{ plf} \times 46.6' = 1827 \\ (1) L2 \times 2 \times 1/4 &= 1 \times 3.2 \text{ plf} \times 46.6' = 149 \text{ @ lights} \\ 2' \text{ of grating} &= 2 \times 5 \text{ psf} \times 46.6' = 466 \end{aligned}$$

Verticals: (6.8' long)

$$2 \times 8 \times L2 \times 2 \times 1/4 = 2 \times 8 \times 6.8' \times 3.2 \text{ plf} = 348$$

Vertical webs (9' long)

$$2 \times 7 \times L2 \times 2 \times 1/4 = 2 \times 7 \times 9' \times 3.2 \text{ plf} = 403$$

Plan steel x-bracing

$$2 \times 46.6 \times \sqrt{2} \times 3.2 \text{ plf} = 422$$

$$2 \times 18 \times 2' \times 1 \text{ plf} = 72$$

$$9 \times 6.5' \times 4 \text{ plf} = 234$$

lighting outrigger

Signs

$$.40 \times 7' \times 4 \text{ psf} = 1120$$

Webs between trusses

$$(6.8' \times \sqrt{2} + 2') \times 3.2 \text{ plf} \times 6 = 223$$

Columns

$$25' \times 55 \text{ plf} \times 2 = 2750$$

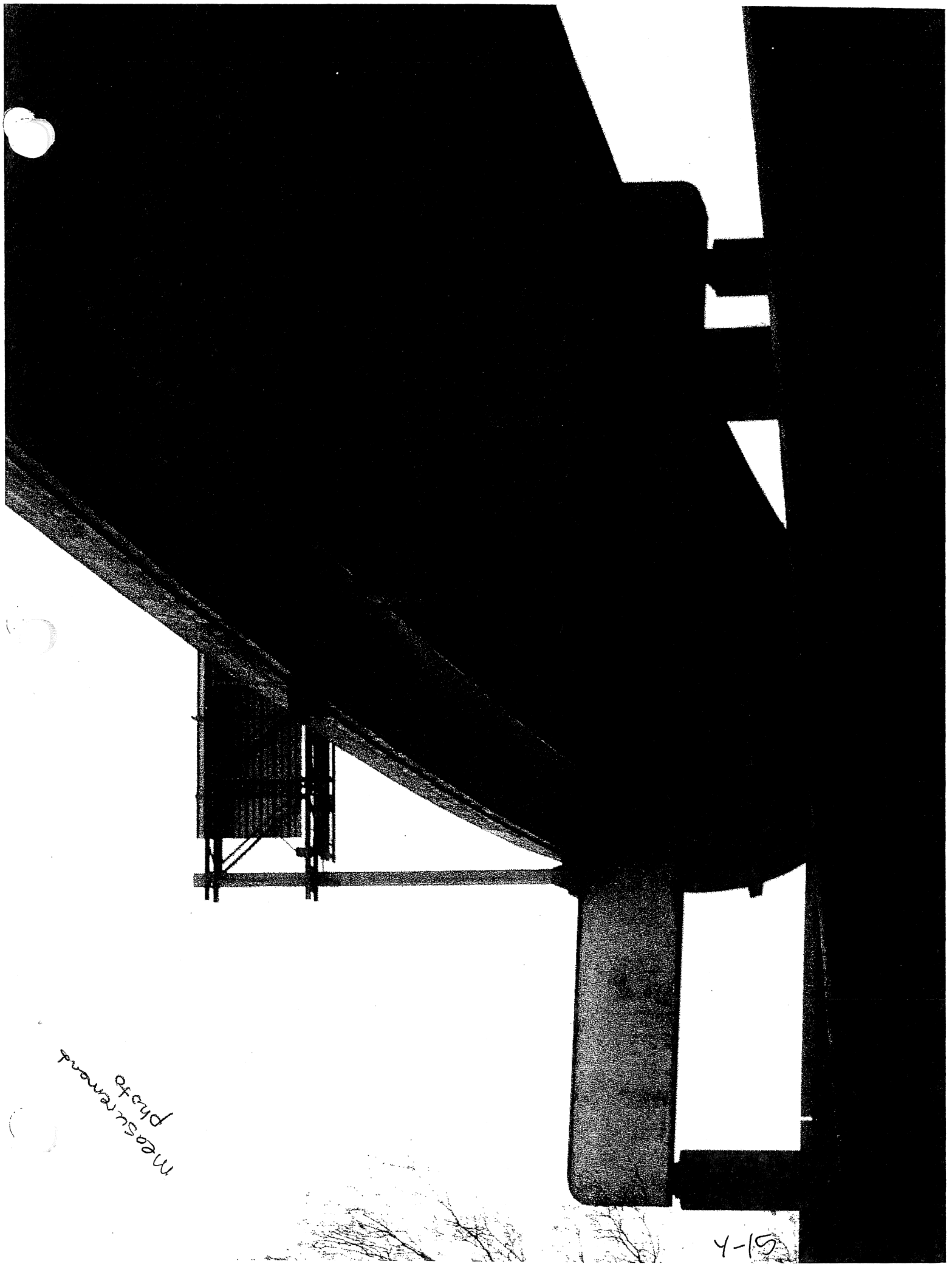
Lights

$$6 \times 20 \text{ lb} = 120$$

$$\Sigma = 8134 \text{ lb}$$

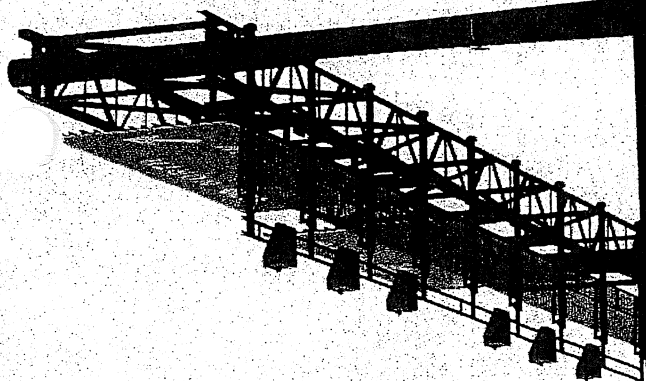
Use 4.5 K @ each support location

4-14



measured
photo

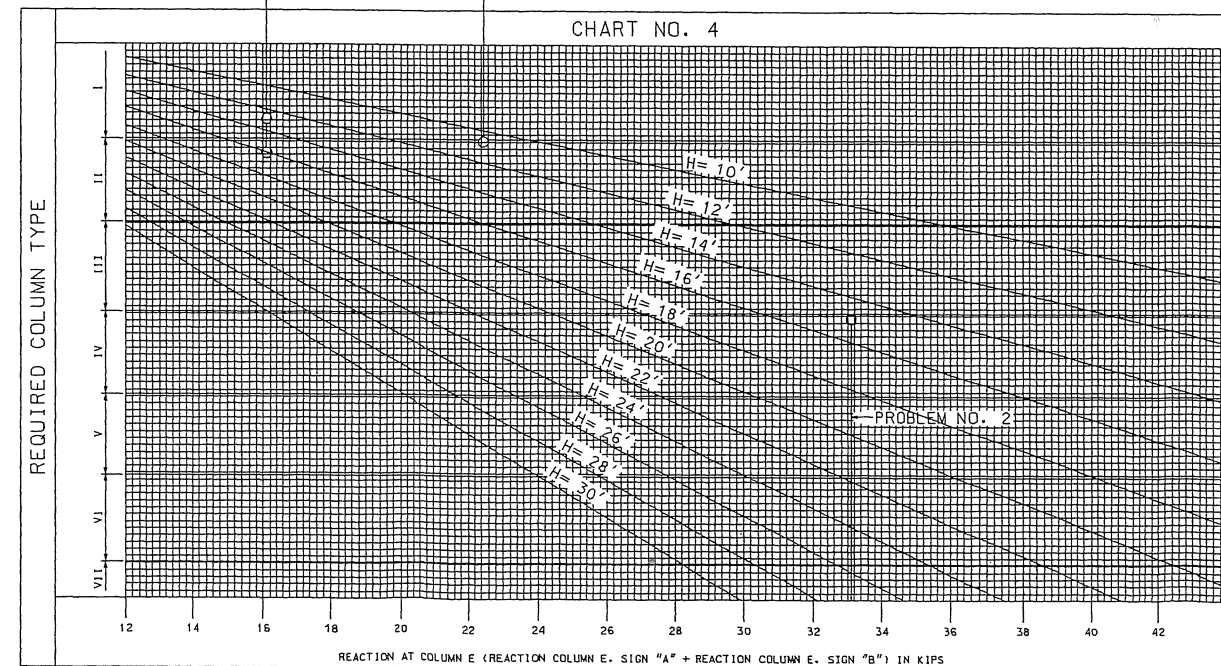
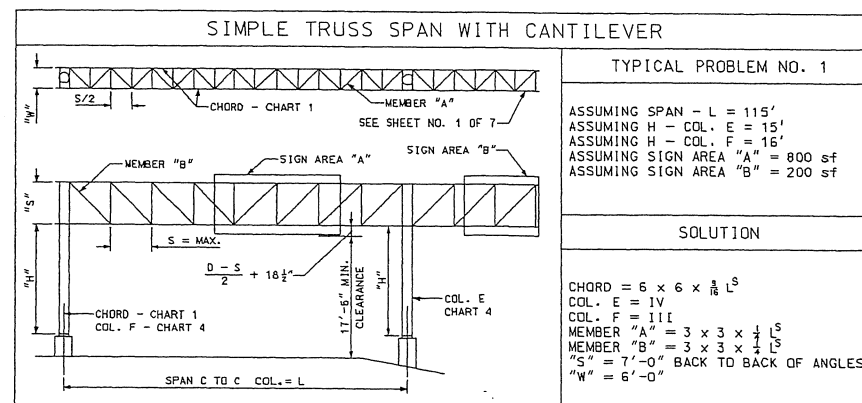
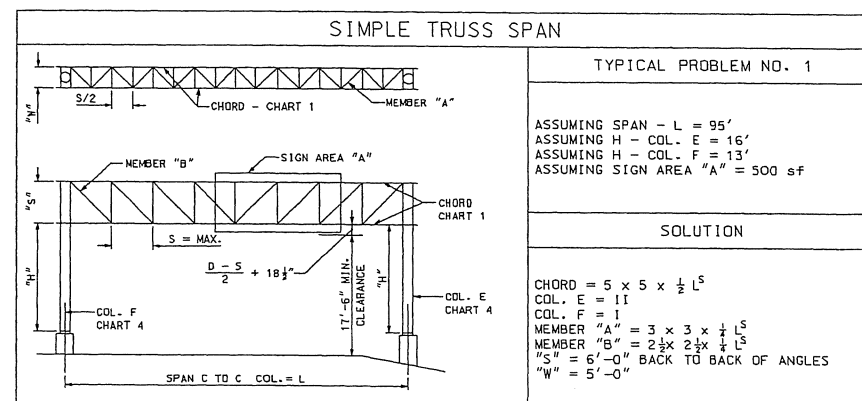
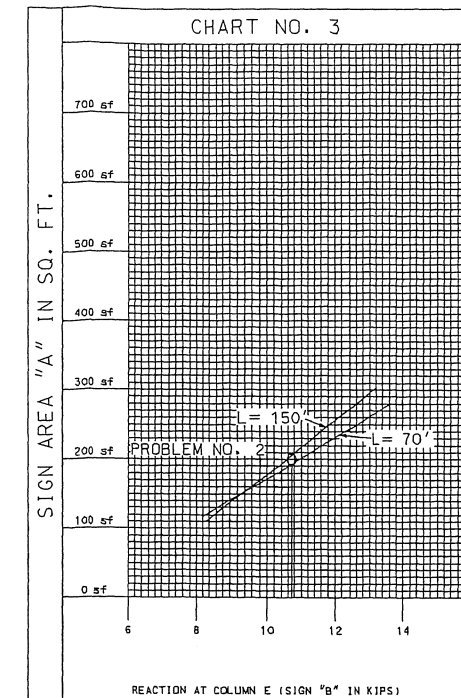
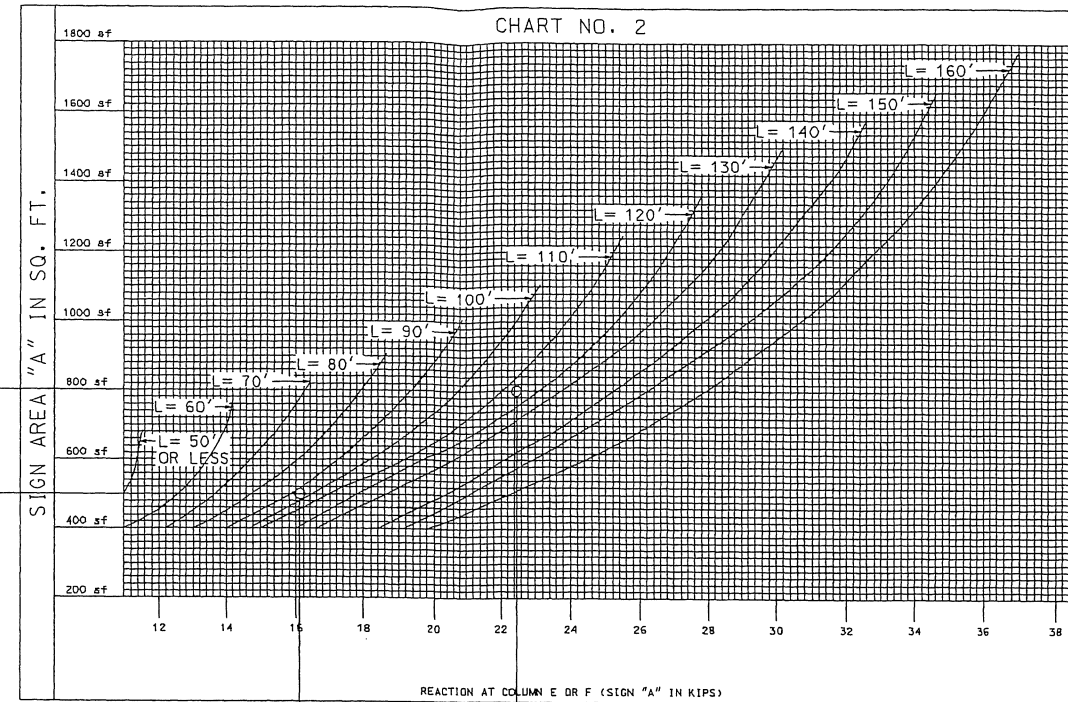
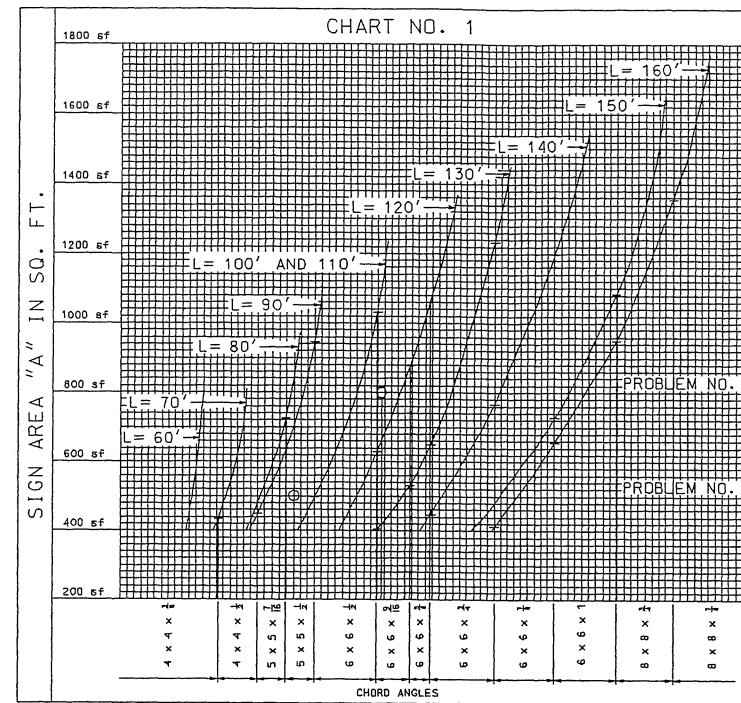
4-15





Y-17

Design Details Overhead Sign Trusses - Structural Steel



NOTE:

THIS SHEET PROVIDES THE INFORMATION NECESSARY TO COMPLETE THE DATA SHEET (D-33) AND SHALL NOT BE INCLUDED IN DESIGN PLANS.

SEE LATEST REVISION OF STANDARD PLAN 903.10.

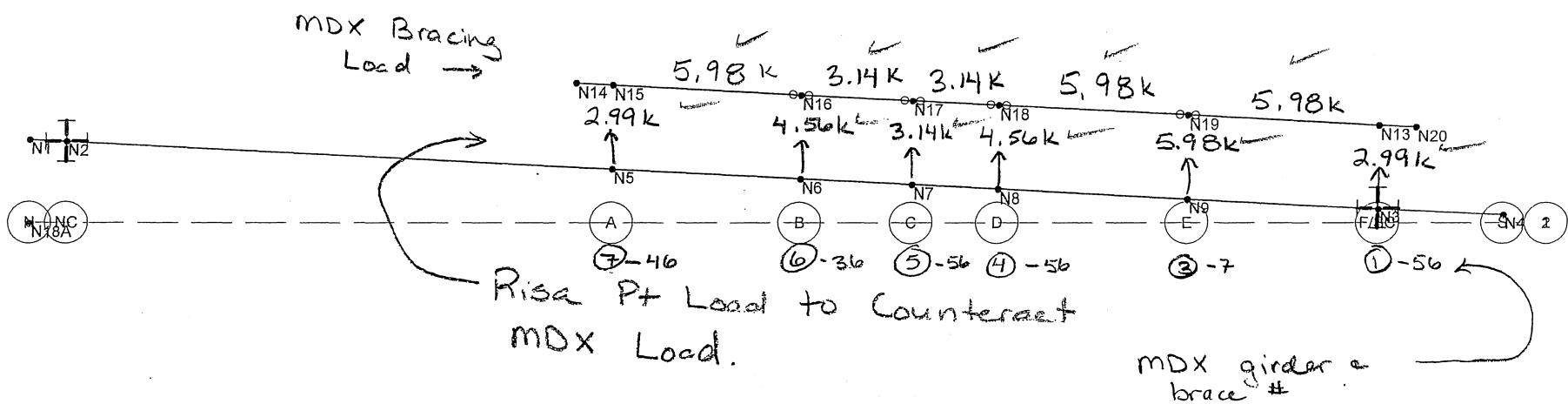
D = GREATEST OVERALL DEPTH OF ANY SIGN OR SIGNS (13'-6" MINIMUM) ON TRUSS.

FOR "W", "S", AND MEMBERS "A", "B" AND "C" SEE TABLE OF TRUSS VARIABLES SHEET FOR "W", "S", AND MEMBERS "A", "B" AND "C" SEE TABLE OF TRUSS VARIABLES SHEET NO. 1 OF 5.

FOR TYPE C TRAFFIC BARRIER PEDESTALS, ADD 0.83 FT. TO THE ESTIMATED COLUMN HEIGHT IN DETERMINING COLUMN TYPE ONLY.

From <http://epg.modot.org/files/1/14/903.3.5.1-Design-Details-Overhead-Sign-Truss-Structural-Steel.pdf>

Figure 903.3.5.1



✓
5/14/10

LHB

jdf

090147

Bridge 69801 3A Pier 6

MDX Bracing Loads

Jan 19, 2010 at 11:29 AM

090147_3A_P6_Pier.r3d

Y-19



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PROJECT Mn DOT SS-69801 - Centrifugal Forces - LRFD - 1
PROJECT # 090147 DATE 1/12/09 BY jaf SHEET NO. 1 OF 1
✓ CSM 5/4/10

Determine Centrifugal forces on pier cap.
See 3.6.3

$$C = f \frac{v^2}{gR}$$

C = Factor to apply to axle weight of the design truck or tandem.

f = $\frac{4}{3}$ for load comb. other than fatigue

v = Design speed (ft/sec)

g = 32.2 ft/sec²

R = Radius of curvature (ft).

P2-3E ✓

S = 30 mph ✓ See JWS calcs 12-7-09 = 44 ft/sec

R = 254.25' ✓

$$C = \frac{4}{3} \times \frac{44^2}{32.2 \times 254.25} = \boxed{0.26}$$

P4-3A

S = 40 mph = 58.7 ft/sec ✓

R = 473.7' ✓

$$C = 0.30 \quad \checkmark$$

P5-3A

S = 50 mph = 73.3 ft/sec ✓

R = 826.26' ✓

$$C = 0.27 \quad \checkmark$$

P6-3A

S = 50 mph = 73.3 ft/sec ✓

R = 826.26' ✓

$$C = 0.27 \quad \checkmark$$



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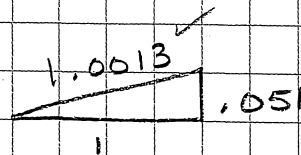
PROJECT MnDOT SS - 69801J - P6-3A - Centrifugal Forces - 1
PROJECT # 090147 DATE 1/19/2010 BY Jdf SHEET NO. 516/10 OF 1

$$S = 50 \text{ mph} \checkmark$$

$$R = 826.26' \checkmark$$

$$C = 0.27 \checkmark$$

$$\text{Superelevation} = 0.051 \text{ ft/ft} \checkmark$$



$$\text{CF balanced by Superelevation} = 0.27 - 0.051 \checkmark = 0.22$$

$\sqrt{2 \text{ lanes}}$

$$\text{Controlling Reaction at pier} = 2 \times 70.6 = 141.2 \text{ k} \checkmark$$

$$\text{Total CF Load} = 0.22 \times 141.2 = 31.1 \text{ k} \checkmark$$

Distribute by "Pile group distribution".

I supports $\Rightarrow$

NA from Beam F:

$$9.05 + 18.08 + 22.2 + 27.53 + 36.53 = 103.4 \checkmark$$

$$I = 18.9^2 + (18.9 - 9.05)^2 + (18.9 - 18.08)^2 + (22.2 - 18.9)^2 + (27.53 - 18.9)^2 + (36.53 - 18.9)^2 = 851.1 \text{ ft}^2 \checkmark$$

$$\text{Moment arm} = 6' \times 1.0013$$

$$+ 1.67'$$

$$+ 1.33'$$

$$+ \frac{1}{2} \times 81'' \div 12''$$

$$= 10.38' \checkmark$$

6' above slab
slab depth
bot slab to T/cap
1/2 cap beam depth

$$P_{\downarrow} \text{ @ beam A} = 31.1 \times 10.38' \times (36.53 - 18.9) \div 851.1 = 6.69 \text{ k}$$

$$P_{\downarrow} \text{ @ beam B} = 31.1 \times 10.38' \times (27.53 - 18.9) \div 851.1 = 3.27 \text{ k}$$

$$P_{\downarrow} \text{ @ beam C} = 31.1 \times 10.38' \times (22.2 - 18.9) \div 851.1 = 1.25 \text{ k}$$

$P_{\downarrow} \text{ @ beams D, E, F} = 0 \text{ kip}$ as can't get uplift.

$$P \leftarrow \text{at each beam C \& of cap beam} = 31.1 \div 6 = 5.18 \text{ k}$$



PROJECT MnDOT-SS-69801 J- P6-3A- Braking Force

-1

PROJECT # 090147 DATE 1/27/10 BY jdf ^{5/16/10} SHEET NO. OF

Determine Braking Force for Pier 6 of 3A, Both Pier 5 and Pier 6 are fixed for these spans between expansion joints.

See P5-3A Braking Force calculations for force distribution between these piers.

Force at Pier 6 is the greater of: (per lane)

1) 25% of axle weight of the design truck
 $= .25 \times (8 + 32 + 32) = 18.0 \text{ kip}$

2) 5% of the design truck plus 5% of the design lane
 $= 0.05 \times (8 + 32 + 32) + 0.05 \times 1640 \times 181.9' = 9.42 \text{ kip}$

* See P5-3A for length

Total Braking Force = 2 lanes $\times$ 18.0 kip = 36.0 kip
to be split between Piers 5 and 6.

See P5-3A Braking Force for Load Sharing between Piers 5 & 6.

P5-3A takes 65.3%

P6-3A takes 34.7%
40.7%

P6-3A Braking Force = $.347 \times 36.0 = 12.5 \text{ kip}$



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PROJECT MnDOT - SS-69801J - P6-3A - Braking Force -2

PROJECT # 090147 DATE 1/27/10 BY jdf SHEET NO. _____ OF _____

5/6/10

Torsion is not considered as piercap is allowed to rotate in the longitudinal direction.

Deck @ pier is 40.0' long. apply braking force as a uniform load to the bridge deck

$$w = \frac{14.7 \text{ k}}{40.0'} = 0.367 \text{ klf}$$



PROJECT MDOT SS-6980 J- P6-3A - Load Distribution along PierCap
PROJECT # 090147 DATE 1/19/10 BY jaF SHEET NO. _____ OF _____
15m
5/6/10

Loads to distribute:

Lane = 65.3 kip ✓ each lane
divide over 10' width = $65.3 \text{ k} \div 10' = 6.53 \text{ klf}$ ✓
and 3.27 klf @ ends

2 Truck @ 50' = 98.0 k each lane ✓
divide over 2 tires = $98.0 \div 2 = 49.0 \text{ k}$ each

Distribute these Loads as if the slab acts as
a simple span between interior beams and
the slab cantilevers over the top of the
exterior beam. ✓

See Risa Loading Print-outs for Moment & Shear
Load Layout.

Determine Load Combination Factors to use in
Risa.

Since $0.9 \text{ Lane} + 0.9 (2 \text{ trucks @ } 50')$ controls,
and impact only applies to the truck load
(or tandem) portion of the live load, (Impact
factor is 1.33).

Use $0.9 \text{ Lane} + \underbrace{0.9 \times 1.33 \times (2 \text{ trucks @ } 50')}_{1.197} + 1.0 \text{ CF}$ ✓

(One Design truck, no I m) —————
+ 1.0 BR ✓



PROJECT MnDOT SS-69801J-P6-3A - One Lane Loading

PROJECT # 090147

DATE 3/17/10

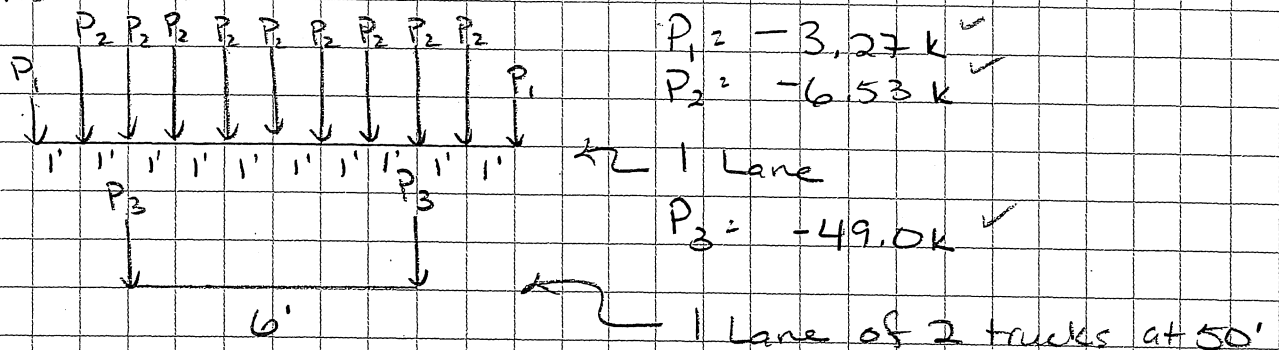
BY jd f

SHEET NO. _____

OF _____

Verify / check if one Lane Loading w/ a multiple Presence Factor, m , of 1.20 controls. See 3.6.1.1.2.

Model a moving Live Load to determine the maximum shear and moment to compare to 2-lane shears and moments.



Combine these moving Loads as Follows

$$\underbrace{(6.53 \times 0.9 \times 1.2) \text{ (Lane)}}_{7.05} + \underbrace{(49 \times 0.9 \times 1.33 \times 1.2) \text{ (2 trucks @ 50')}}_{70.4} + \underbrace{1.2 \times 0.5 \text{ (BR + CF)}}_{0.6}$$

One Lane

2 Lanes

V north

120.4 k ✓

163.7 k ✓

V south

171.8 k ✓

259.0 k ✓

M_x

3050.0 k-ft ✓

4641.8 k-ft ✓

M_y

66.0 k-ft ✓

110.1 k-ft ✓

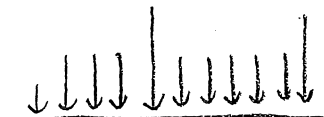
All One Lane Forces are less than 2-lane Forces.

2 Lanes will control

Envelope Member Section Forces

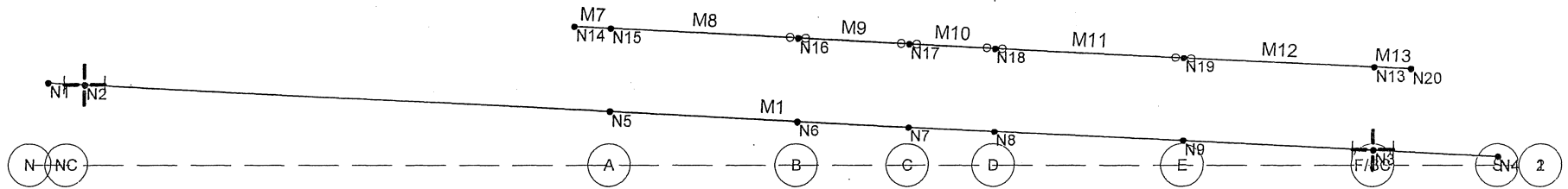
	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-ft]	LC	y-y Momen...	LC	z-z Momen...	LC
1	M1	1	max	0	4	0	4	0	4	0	4	0	4	0	4
2			min	0	4	0	4	0	4	0	4	0	4	0	4
3		2	max	5.325	4	120.443	4	-2.201	4	.002	4	-4.278	4	-3.291	4
4			min	-.38	4	1.693	4	-2.201	4	.002	4	-4.278	4	-234.091	4*
5		3	max	5.325	4	120.443	4	-2.201	4	.002	4	-12.414	4	-9.549	4
6			min	-.38	4	1.693	4	-2.201	4	.002	4	-12.414	4	-679.229	4
7		4	max	5.325	4	120.443	4	-2.201	4	.002	4	-20.549	4	-15.807	4
8			min	-.38	4	1.693	4	-2.201	4	.002	4	-20.549	4	-1124.368	4
9		5	max	5.325	4	120.443	4	-2.201	4	.002	4	-28.684	4	-22.066	4
10			min	-.38	4	1.693	4	-2.201	4	.002	4	-28.684	4	-1569.506	4
11		6	max	5.325	4	120.443	4	-2.201	4	.002	4	-36.82	4	-28.324	4
12			min	-.38	4	1.693	4	-2.201	4	.002	4	-36.82	4	-2014.644	4
13		7	max	5.325	4	120.443	4	-2.201	4	.002	4	-44.955	4	-34.582	4
14			min	-.38	4	1.693	4	-2.201	4	.002	4	-44.955	4	-2459.782	4
15		8	max	5.325	4	120.443	4	-2.201	4	.002	4	-53.09	4	-40.84	4
16			min	-.38	4	1.693	4	-2.201	4	.002	4	-53.09	4	-2904.92	4
17		9	max	4.471	4	80.003	4	-.994	4	.002	4	-58.991	4	-39.385	4
18			min	-1.482	4	-56.698	4	-.994	4	.002	4	-58.991	4	-3038.317	4
19		10	max	4.471	4	80.003	4	-.994	4	.002	4	-62.665	4	-30.243	4
20			min	-1.482	4	-56.698	4	-.994	4	.002	4	-62.665	4	-2939.485	4
21		11	max	4.656	4	59.909	4	.321	4	.002	4	-66.035	4	-20.612	4
22			min	-3.479	4	-108.115	4	.321	4	.002	4	-66.035	4	-3049.97	4
23		12	max	4.656	4	59.909	4	.321	4	.002	4	-64.847	4	-3.642	4
24			min	-3.479	4	-108.115	4	.321	4	.002	4	-64.847	4	-2891.095	4
25		13	max	2.604	4	44.923	4	1.21	4	.002	4	-61.628	4	15.401	4
26			min	-5.706	4	-126.737	4	1.21	4	.002	4	-61.628	4	-2659.553	4
27		14	max	.351	4	14.397	4	2.446	4	.002	4	-54.862	4	36.018	4
28			min	-7.208	4	-141.042	4	2.446	4	.002	4	-54.862	4	-2320.475	4
29		15	max	.351	4	14.397	4	2.446	4	.002	4	-45.821	4	56.927	4
30			min	-7.208	4	-141.042	4	2.446	4	.002	4	-45.821	4	-1815.471	4
31		16	max	-1.173	4	8.461	4	4.114	4	.002	4	-36.436	4	74.926	4
32			min	-9.295	4	-171.762	4	4.114	4	.002	4	-36.436	4	-1521.071	4
33		17	max	-1.173	4	8.461	4	4.114	4	.002	4	-21.23	4	43.656	4
34			min	-9.295	4	-171.762	4	4.114	4	.002	4	-21.23	4	-886.265	4
35		18	max	-1.173	4	8.461	4	4.114	4	.002	4	-6.023	4	12.387	4
36			min	-9.295	4	-171.762	4	4.114	4	.002	4	-6.023	4	-251.46	4
37		19	max	0	4	0	4	0	4	0	4	0	4	0	4
38			min	0	4	0	4	0	4	0	4	0	4	0	4
39		20	max	0	4	0	4	0	4	0	4	0	4	0	4
40			min	0	4	0	4	0	4	0	4	0	4	0	4

Moving LL, one Lane, for comparison to
 2-lane Loadings.



This layout controlled.

C9801J-3A-P6
Model Input



LHB

jdf

090147

Bridge 69801 3A Pier 6

June 28, 2010 at 3:13 PM

090147_3A_P6_Pier.r3d

1-7

Company : LHB
 Designer : jdf
 Job Number : 090147

Bridge 69801 3A Pier 6

Apr 19, 2010
 2:24 PM
 Checked By: *CJM*

5/6/10

Global

Display Sections for Member Calcs	20
Max Internal Sections for Member Calcs	191
Include Shear Deformation	Yes
Include Warping	No
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Vertical Axis	Y

Hot Rolled Steel Code	AISC : LRFD 13th
Cold Formed Steel Code	AISI 01: ASD
Wood Code	NDS 2005: ASD
Wood Temperature	< 100F
Concrete Code	ACI 2005
Masonry Code	MSJC 05/IBC 06 ASD

Number of Shear Regions	4
Region Spacing Increment (in)	4
Biaxial Column Method	Exact Integration
Parame Beta Factor (PCA)	.65
Concrete Stress Block	Rectangular
Use Cracked Sections	Yes
Bad Framing Warnings	No
Unused Force Warnings	Yes

Footing Overturning Safety Factor	1.5
Check Concrete Bearing	Yes
Self Wt, Overburden in DL for Design	Yes
Footing Concrete Weight	.145 k/ft^3
Footing Concrete f _c	3 ksi
Footing Concrete E _c	4000 ksi
Footing Steel f _y	60 ksi
Minimum Steel	0.0018
Maximum Steel	0.0075
Footing Top Bar	#3
Footing Top Bar Cover	3.5 in
Footing Bottom Bar	#4
Footing Bottom Bar Cover	3.5 in
Pedestal Bar	#3
Pedestal Bar Cover	1.5 in
Pedestal Ties	#3

General Material Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (1E5 F)	Density[k/ft^3]
1	A36 Steel	29000	11154	.3	.65	.49

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (1E5 F)	Density[k/ft^3]	Yield[ksi]
1	A36	29000	11154	.3	.65	.49	36

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rules	A [in2]	I _{yy} [in4]	I _{zz} [in4]	J [in4]
1	Slab	W8X40	Beam	None	A36	Typical	11.7	49.1	146	1.12

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Member Primary Data

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1	N1	N4			BR3A-P6-1	Beam	None	A36 Steel	Default
2	M7	N14	N15			Slab	Beam	None	A36	Typical
3	M8	N15	N16			Slab	Beam	None	A36	Typical
4	M9	N16	N17			Slab	Beam	None	A36	Typical
5	M10	N17	N18			Slab	Beam	None	A36	Typical
6	M11	N18	N19			Slab	Beam	None	A36	Typical
7	M12	N19	N13			Slab	Beam	None	A36	Typical
8	M13	N13	N20			Slab	Beam	None	A36	Typical

Member Advanced Data

	Label	I Release	J Release	I Offset[in]	J Offset[in]	T/C Only	Physical	TOM	Inactive
1	M1						Yes	Yes	
2	M7						Yes	Yes	
3	M8		BenPIN				Yes	Yes	
4	M9	BenPIN	BenPIN				Yes	Yes	
5	M10	BenPIN	BenPIN				Yes	Yes	
6	M11	BenPIN	BenPIN				Yes	Yes	
7	M12	BenPIN					Yes	Yes	
8	M13						Yes	Yes	

Joint Coordinates and Temperatures

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
1	N1	0	43.958	0	0	
2	N2	175.258	3.911	0	0	
3	N3	64.21	.725	0	0	
4	N4	70.13	.423	0	0	
5	N5	27.68	2.589	0	0	
6	N6	36.6805	2.129	0	0	
7	N7	42.01	1.857	0	0	
8	N8	46.13	1.647	0	0	
9	N9	55.16	1.187	0	0	
10	N13	64.21	4.725	0	0	
11	N14	25.93	6.678	0	0	
12	N15	27.68	6.589	0	0	
13	N16	36.6805	6.129	0	0	
14	N17	42.01	5.857	0	0	
15	N18	46.13	5.647	0	0	
16	N19	55.16	5.187	0	0	
17	N20	65.96	4.636	0	0	
18	N18A	0	0	0	0	

Joint Boundary Conditions

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot.[k-ft/rad]	Y Rot.[k-ft/rad]	Z Rot.[k-ft/rad]	Footings
1	N2	Reaction	Reaction	Reaction	Reaction			
2	N3	Reaction	Reaction	Reaction	Reaction			
3	N13	SlaveN3	SlaveN3	SlaveN3	SlaveN3			
4	N15	SlaveN5	SlaveN5	SlaveN5	SlaveN5			
5	N16	SlaveN6	SlaveN6	SlaveN6	SlaveN6			
6	N17	SlaveN7	SlaveN7	SlaveN7	SlaveN7			
7	N18	SlaveN8	SlaveN8	SlaveN8	SlaveN8			
8	N19	SlaveN9	SlaveN9	SlaveN9	SlaveN9			

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Joint Loads and Enforced Displacements (BLC 6 : Centrifugal Force)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N5	L	Y	-6.69
2	N6	L	Y	-3.27
3	N7	L	Y	-1.25
4	N5	L	X	-5.18
5	N6	L	X	-5.18
6	N7	L	X	-5.18
7	N8	L	X	-5.18
8	N9	L	X	-5.18
9	N3	L	X	-5.18

Joint Loads and Enforced Displacements (BLC 7 : Noncomp Dead)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N3	L	Y	-107.97
2	N9	L	Y	-112.81
3	N8	L	Y	-74.65
4	N7	L	Y	-90.56
5	N6	L	Y	-84.3
6	N5	L	Y	-109.61

Joint Loads and Enforced Displacements (BLC 8 : Superimposed Dead)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N5	L	Y	-20.81
2	N6	L	Y	-20.43
3	N7	L	Y	-16.1
4	N8	L	Y	-20.18
5	N9	L	Y	-20.86
6	N3	L	Y	-21.37

Joint Loads and Enforced Displacements (BLC 10 : MDX Bracing Weight)

	Joint Label	L,D,M	Direction	Magnitude[(k,k-ft), (in.rad), (k*s^2/ft...]
1	N5	L	Y	2.99
2	N6	L	Y	4.56
3	N7	L	Y	3.14
4	N8	L	Y	4.56
5	N9	L	Y	5.98
6	N3	L	Y	2.99

Member Point Loads (BLC 2 : Lane Moment)

5/21/10 ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M18	Y	-3.27	0 0.25
2	M18	Y	-6.53	1 1.25
3	M8	Y	-6.53	25 2.25
4	M8	Y	-6.53	1.25 3.25
5	M8	Y	-6.53	2.25 4.25
6	M8	Y	-6.53	3.25 5.25
7	M8	Y	-6.53	4.25 6.25
8	M8	Y	-6.53	5.25 7.25
9	M8	Y	-6.53	6.25 8.25
10	M89	Y	-6.53	7.25 0.25
11	M89	Y	-3.27	8.25 1.25
12	M9	Y	-3.27	1.25
13	M9	Y	-6.53	2.25
14	M9	Y	-6.53	3.25
15	M9	Y	-6.53	4.25

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Member Point Loads (BLC 2 : Lane Moment) (Continued)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
16	M9	Y	-6.53	5.25
17	M10	Y	-6.53	.92
18	M10	Y	-6.53	1.92
19	M10	Y	-6.53	2.92
20	M10	Y	-6.53	3.92
21	M11	Y	-6.53	.8
22	M11	Y	-3.27	1.8

Member Point Loads (BLC 3 : Lanes Shear)

5/2/10 ✓

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M8 ✓ 9	Y	-3.27	8.48 1.48
2	M9	Y	-6.53	.48 2.48
3	M9	Y	-6.53	1.48 3.48
4	M9	Y	-6.53	2.48 4.48
5	M8 ✓ 10	Y	-6.53	3.48 0.15
6	M9 ✓ 10	Y	-6.53	4.48 1.15
7	M10	Y	-6.53	.15 2.15
8	M10	Y	-6.53	1.15 3.15
9	M10 ✓ 11	Y	-6.53	2.15 0.03
10	M10 ✓ 11	Y	-6.53	3.15 1.03
11	M11	Y	-3.27	.03 2.03
12	M11	Y	-3.27	2.03
13	M11	Y	-6.53	3.03
14	M11	Y	-6.53	4.03
15	M11	Y	-6.53	5.03
16	M11	Y	-6.53	6.03
17	M11	Y	-6.53	7.03
18	M11	Y	-6.53	8.03
19	M12	Y	-6.53	0
20	M12	Y	-6.53	1
21	M12	Y	-6.53	2
22	M12	Y	-3.27	3

Member Point Loads (BLC 4 : 2 Truck at 50 Moment)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M8	Y	-49	.25
2	M8	Y	-49	6.25
3	M9	Y	-49	1.25
4	M10	Y	-49	1.921

Member Point Loads (BLC 5 : 2 Truck at 50 Shear)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M9	Y	-49	2.48
2	M10	Y	-49	3.15
3	M11	Y	-49	3.03
4	M12	Y	-49	0

Member Point Loads (BLC 9 : Sign Bridge Weight)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M1	Y	-4.5	21.69
2	M1	Y	-4.5	69.3

Member Point Loads (BLC 11 : Braking Force)

	Member Label	Direction	Magnitude[k,k-ft]	Location[ft, %]
1	M1	Y	0	0

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Member Point Loads (BLC 12 : Mom Type 3 + SU7)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M8	Y	-38.06	3
2	M9	Y	-38.06	0
3	M9	Y	-23.77	4
4	M11	Y	-23.77	.55

Member Point Loads (BLC 13 : Mom Type 3S2-40 + SU7)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M8	Y	-38.06	.25
2	M8	Y	-38.06	6.25
3	M9	Y	-36.74	1.25
4	M10	Y	-36.74	1.921

Member Point Loads (BLC 14 : Mom Type 3S3 + SU7)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M8	Y	-38.06	.25
2	M8	Y	-38.06	6.25
3	M9	Y	-37.26	1.25
4	M10	Y	-37.26	1.921

Member Point Loads (BLC 15 : Mom Std A + SU7)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M8	Y	-49.35	3
2	M9	Y	-49.35	0
3	M9	Y	-38.06	4
4	M11	Y	-38.06	.55

Member Point Loads (BLC 16 : Mom Std B + SU7)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M8	Y	-63.18	3
2	M9	Y	-63.18	0
3	M9	Y	-38.06	4
4	M11	Y	-38.06	.55

Member Point Loads (BLC 17 : Mom Std C +SU7)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M8	Y	-72.47	3
2	M9	Y	-72.47	0
3	M9	Y	-38.06	4
4	M11	Y	-38.06	.55

Member Point Loads (BLC 18 : Mom P411 + SU7)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M8	Y	-79.82	3
2	M9	Y	-79.82	0
3	M9	Y	-38.06	4
4	M11	Y	-38.06	.55

Member Point Loads (BLC 19 : Mom P413 + SU7)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M8	Y	-88.52	3
2	M9	Y	-88.52	0
3	M9	Y	-38.06	4
4	M11	Y	-38.06	.55

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Member Point Loads (BLC 20 : Mom Std C152b + SU7)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M8	Y	-69.96	3
2	M9	Y	-69.96	0
3	M9	Y	-38.06	4
4	M11	Y	-38.06	.55

Member Point Loads (BLC 21 : Mom Std C174b + SU7)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M8	Y	-77.41	3
2	M9	Y	-77.41	0
3	M9	Y	-38.06	4
4	M11	Y	-38.06	.55

Member Point Loads (BLC 22 : Mom Std C198 23 + SU7)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M8	Y	-82.78	3
2	M9	Y	-82.78	0
3	M9	Y	-38.06	4
4	M11	Y	-38.06	.55

Member Point Loads (BLC 23 : Mom Std 214b + SU7)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M8	Y	-86.39	3
2	M9	Y	-86.39	0
3	M9	Y	-38.06	4
4	M11	Y	-38.06	.55

Member Point Loads (BLC 24 : Mom Std C237b + SU7)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M8	Y	-87.3	3
2	M9	Y	-87.3	0
3	M9	Y	-38.06	4
4	M11	Y	-38.06	.55

Member Point Loads (BLC 25 : Mom Std C256b + SU7)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M8	Y	-88.37	3
2	M9	Y	-88.37	0
3	M9	Y	-38.06	4
4	M11	Y	-38.06	.55

Member Point Loads (BLC 26 : Mom Std C200j + SU7)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M8	Y	-86.16	3
2	M9	Y	-86.16	0
3	M9	Y	-38.06	4
4	M11	Y	-38.06	.55

Member Point Loads (BLC 27 : Mom Std A)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M8	Y	-49.35	3
2	M9	Y	-49.35	0

Member Point Loads (BLC 28 : Mom Std B)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
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Company : LHB
Designer : jdf
Job Number : 090147

Bridge 69801 3A Pier 6

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2:24 PM
Checked By: *CSM*

5/7/10

Member Point Loads (BLC 28 : Mom Std B) (Continued)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M8	Y	-63.18	3
2	M9	Y	-63.18	0

Member Point Loads (BLC 29 : Mom Std C)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M8	Y	-72.47	3
2	M9	Y	-72.47	0

Member Point Loads (BLC 30 : Mom P411)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M8	Y	-79.82	3
2	M9	Y	-79.82	0

Member Point Loads (BLC 31 : Mom P413)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M8	Y	-88.52	3
2	M9	Y	-88.52	0

Member Point Loads (BLC 32 : Mom Std C152b)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M8	Y	-69.96	3
2	M9	Y	-69.96	0

Member Point Loads (BLC 33 : Mom Std C174b)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M8	Y	-77.41	3
2	M9	Y	-77.41	0

Member Point Loads (BLC 34 : Mom Std C198 23)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M8	Y	-82.78	3
2	M9	Y	-82.78	0

Member Point Loads (BLC 35 : Mom Std 214b)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M8	Y	-86.39	3
2	M9	Y	-86.39	0

Member Point Loads (BLC 36 : Mom Std C237b)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M8	Y	-87.3	3
2	M9	Y	-87.3	0

Member Point Loads (BLC 37 : Mom Std C256b)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M8	Y	-88.37	3
2	M9	Y	-88.37	0

Member Point Loads (BLC 38 : Mom Std C200j)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft. %]
1	M8	Y	-86.16	3
2	M9	Y	-86.16	0

Company : LHB
 Designer : jdf
 Job Number : 090147

Bridge 69801 3A Pier 6

Apr 19, 2010
 2:24 PM
 Checked By: *CTM*

5/7/10

Member Point Loads (BLC 39 : Shr P413 + SU7)

	Member Label	Direction	Magnitude[k.k-ft]	Location[ft.%]
1	M9	Y	-38.06	2.48
2	M10	Y	-38.06	3.15
3	M11	Y	-88.52	3.03
4	M12	Y	-88.52	0

Member Distributed Loads (BLC 1 : Pier Cap Weight)

	Member Label	Direction	Start Magnitude[k/ft.d]	End Magnitude[k/ft.d]	Start Location[ft.%]	End Location[ft.%]
1	M1	Y	-788	-788	0	0

Member Distributed Loads (BLC 11 : Braking Force)

	Member Label	Direction	Start Magnitude[k/ft.d]	End Magnitude[k/ft.d]	Start Location[ft.%]	End Location[ft.%]
1	M7	Z	.313	.313	0	0
2	M8	Z	.313	.313	0	0
3	M9	Z	.313	.313	0	0
4	M10	Z	.313	.313	0	0
5	M11	Z	.313	.313	0	0
6	M12	Z	.313	.313	0	0
7	M13	Z	.313	.313	0	0

366V

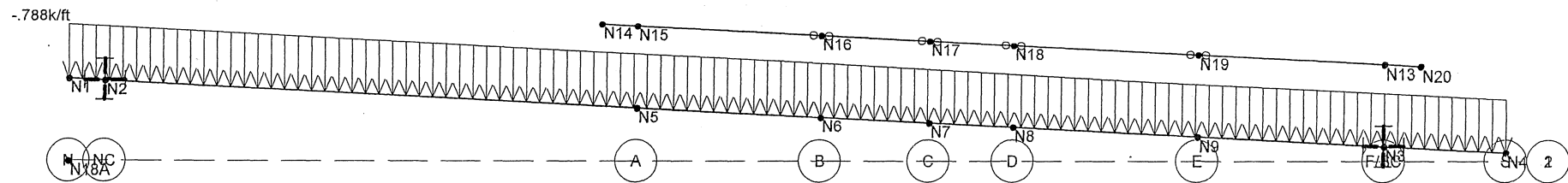
Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distributed Area (Me...	Surface (...)
1	Pier Cap Weight	DL						1	
2	Lane Moment	LL					22		
3	Lanes Shear	LL					22		
4	2 Truck at 50 Moment	LL					4		
5	2 Truck at 50 Shear	LL					4		
6	Centrifugal Force	LL				9			
7	Noncomp Dead	DL				6			
8	Superimposed Dead	DL				6			
9	Sign Bridge Weight	DL					2		
10	MDX Bracing Weight	DL				6			
11	Braking Force	LL					1	7	
12	Mom Type 3 + SU7	LL					4		
13	Mom Type 3S2-40 + ...	LL					4		
14	Mom Type 3S3 + SU7	LL					4		
15	Mom Std A + SU7	LL					4		
16	Mom Std B + SU7	LL					4		
17	Mom Std C +SU7	LL					4		
18	Mom P411 + SU7	LL					4		
19	Mom P413 + SU7	LL					4		
20	Mom Std C152b + SU7	LL					4		
21	Mom Std C174b + SU7	LL					4		
22	Mom Std C198_23 + ...	LL					4		
23	Mom Std 214b + SU7	LL					4		
24	Mom Std C237b + SU7	LL					4		
25	Mom Std C256b + SU7	LL					4		
26	Mom Std C200j + SU7	LL					4		
27	Mom Std A	LL					2		
28	Mom Std B	LL					2		
29	Mom Std C	LL					2		
30	Mom P411	LL					2		
31	Mom P413	LL					2		
32	Mom Std C152b	LL					2		
33	Mom Std C174b	LL					2		

2-9

Checked By: CA

5/10/0



165m
5/7/10

Loads: BLC 1, Pier Cap Weight

LHB

jdf

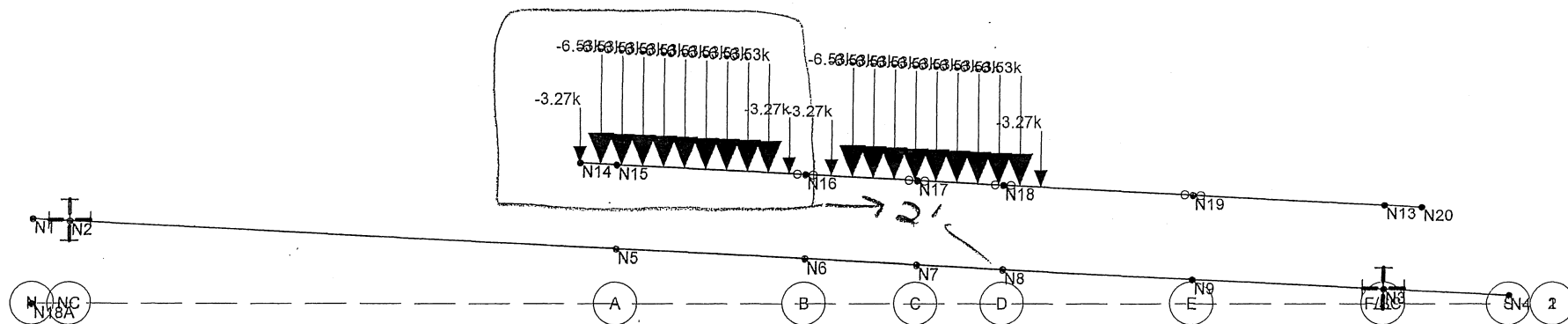
090147

Bridge 69801 3A Pier 6

Jan 19, 2010 at 2:18 PM

090147_3A_P6_Pier.r3d

11-2



Loads: BLC 2, Lane Moment

LHB

jdf

090147

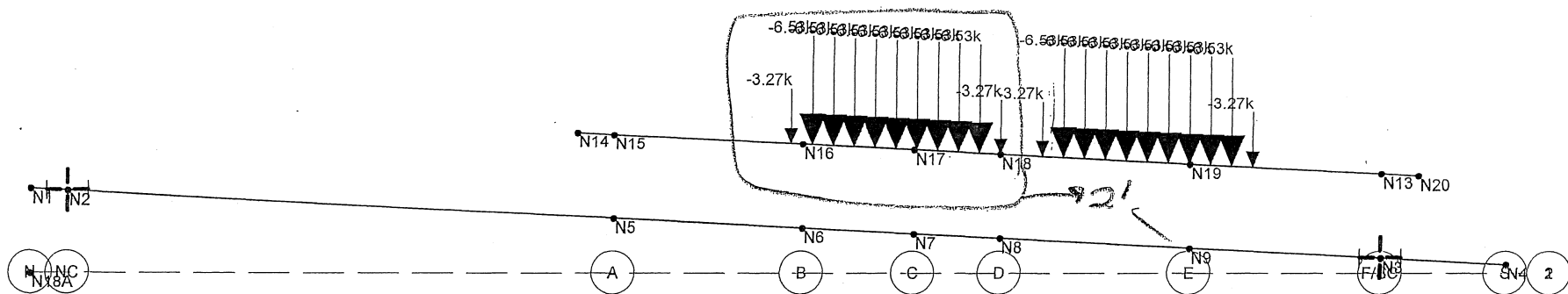
Bridge 69801 3A Pier 6

Jan 19, 2010 at 2:18 PM

090147_3A_P6_Pier.r3d

1cm
5/6/10

2-12



Loads: BLC 3, Lanes Shear

LHB

jdf

090147

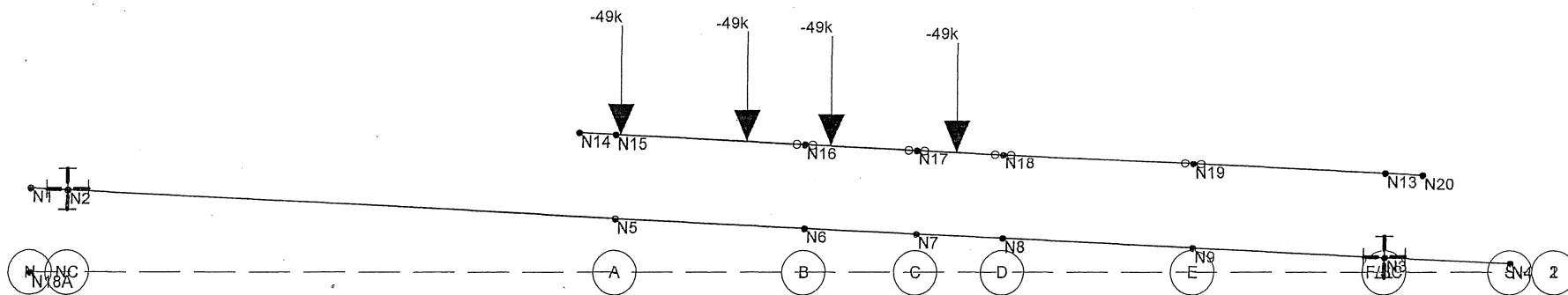
Bridge 69801 3A Pier 6

Feb 2, 2010 at 1:01 PM

090147_3A_P6_Pier.r3d

JCSM
5/7/10

2-13

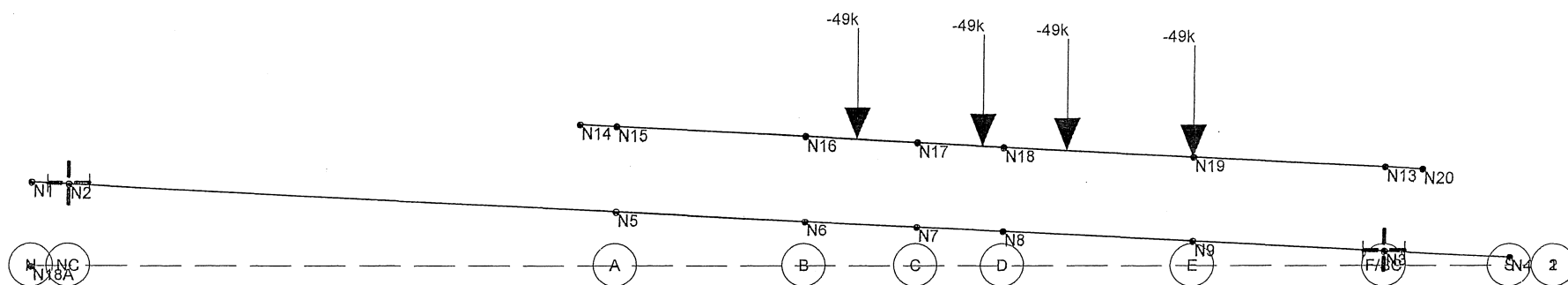


Loads: BLC 4, 2 Truck at 50 Moment

LHB	Bridge 69801 3A Pier 6	
jdf		Jan 19, 2010 at 2:18 PM
090147		090147_3A_P6_Pier.r3d

UCSM
57110

214

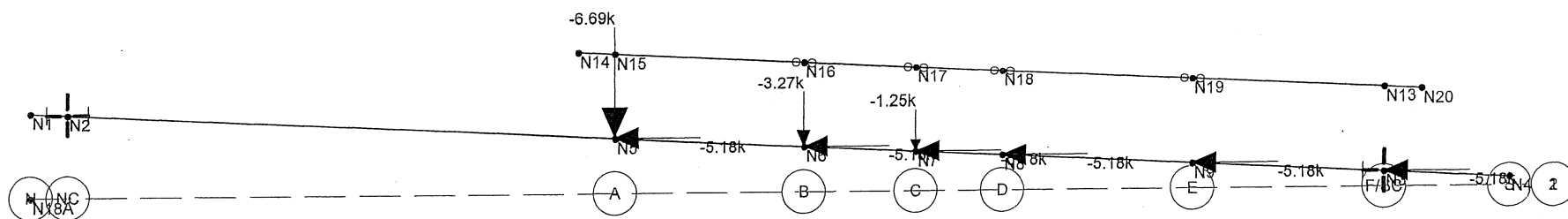


UCSW
5/11/10

Loads: BLC 5, 2 Truck at 50 Shear

LHB	Bridge 69801 3A Pier 6	
jdf		Feb 2, 2010 at 1:02 PM
090147		090147_3A_P6_Pier.r3d

2-15



UCFM
5/16/10

Loads: BLC 6, Centrifugal Force

LHB

jdf

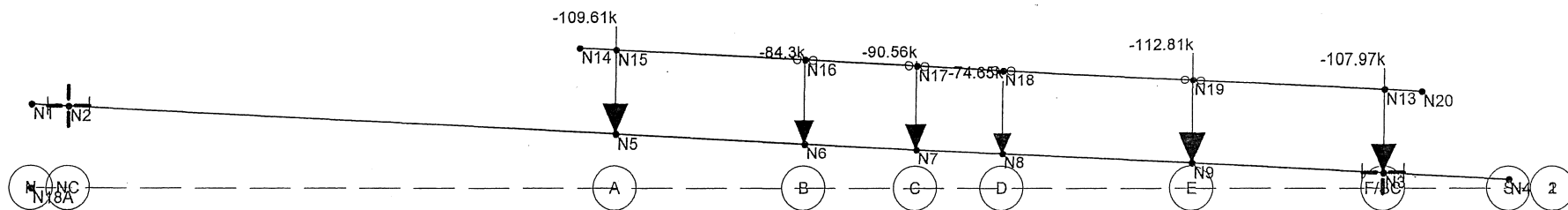
090147

Bridge 69801 3A Pier 6

Feb 1, 2010 at 4:12 PM

090147_3A_P6_Pier.r3d

7-16



UCSM
5/6/10

Loads: BLC 7, Noncomp Dead

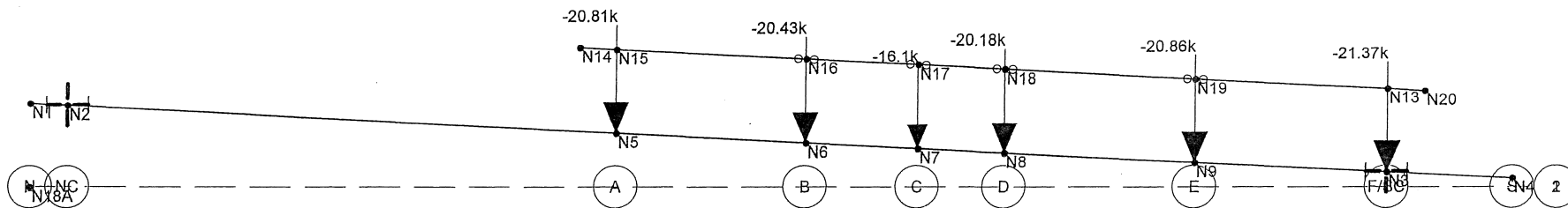
LHB
jdf
090147

Bridge 69801 3A Pier 6

Jan 28, 2010 at 10:47 AM

090147_3A_P6_Pier.r3d

7-17



VC5M
5/6/10

Loads: BLC 8, Superimposed Dead

LHB

jdf

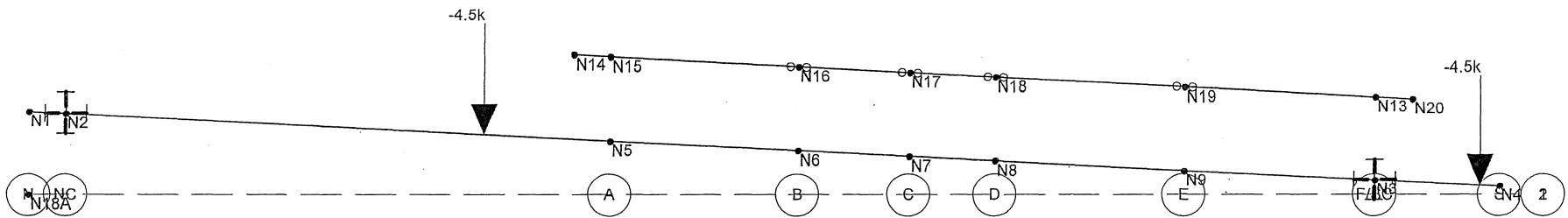
090147

Bridge 69801 3A Pier 6

Jan 28, 2010 at 10:47 AM

090147_3A_P6_Pier.r3d

21-2



Loads: BLC 9, Sign Bridge Weight

LHB

jdf

090147

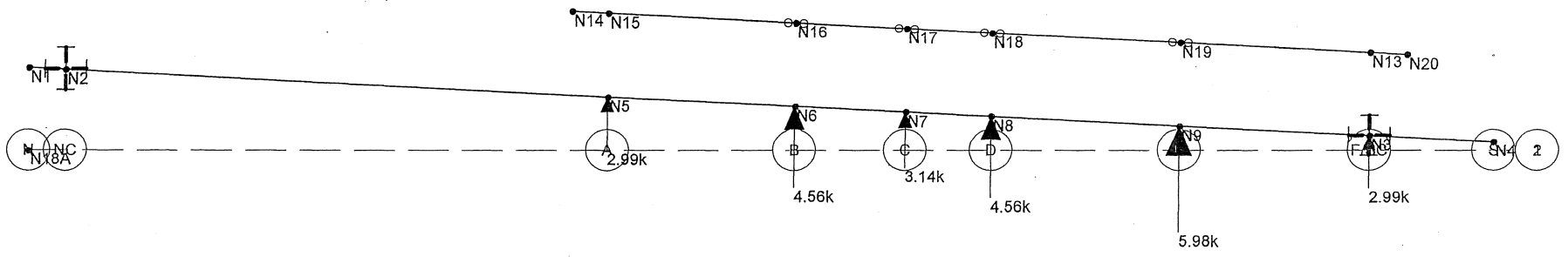
Bridge 69801 3A Pier 6

Jan 19, 2010 at 2:19 PM

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JCSM
5/17/10

2-19

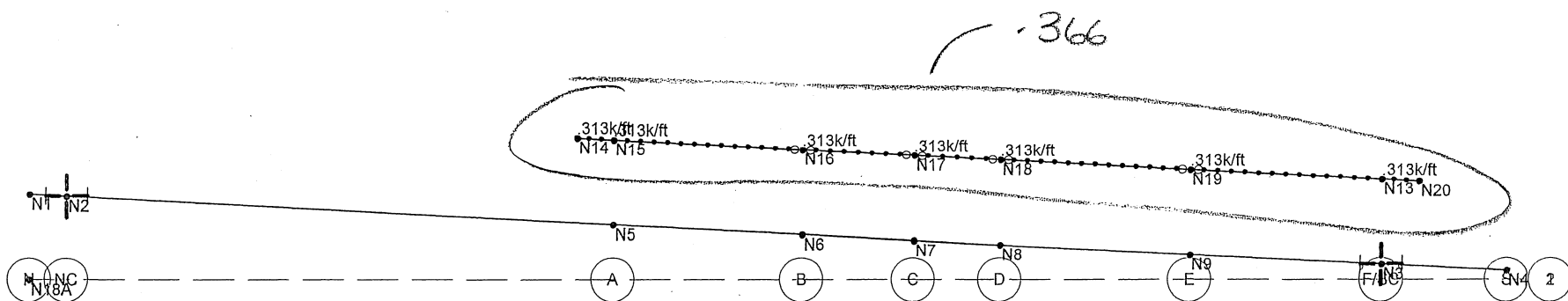


100m
5/6/10

Loads: BLC 10, MDX Bracing Weight

LHB	Bridge 69801 3A Pier 6	
jdf		Jan 19, 2010 at 2:19 PM
090147		090147_3A_P6_Pier.r3d

2-20



105m
5/7/16

Loads: BLC 11, Braking Force

LHB

jdf

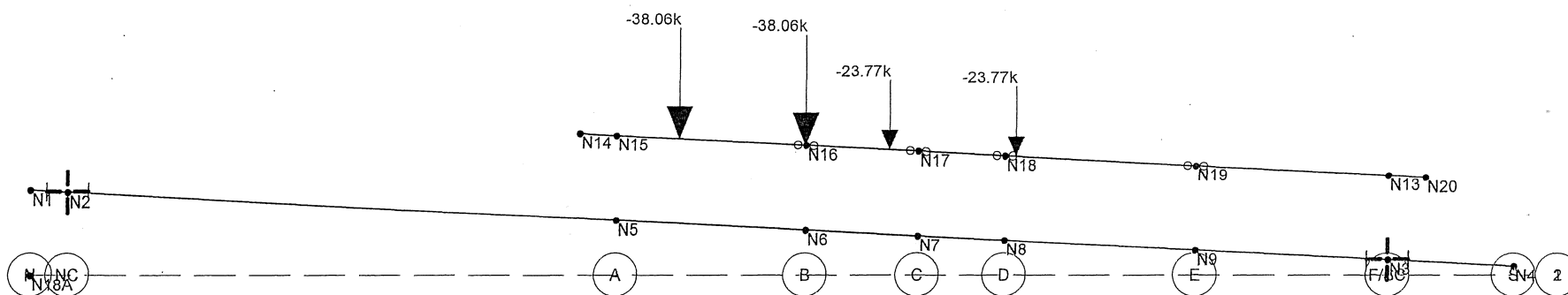
090147

Bridge 69801 3A Pier 6

Feb 1, 2010 at 4:13 PM

090147_3A_P6_Pier.r3d

2-21



165m
5/7/10

Loads: BLC 12, Mom Type 3 + SU7

LHB

jdf

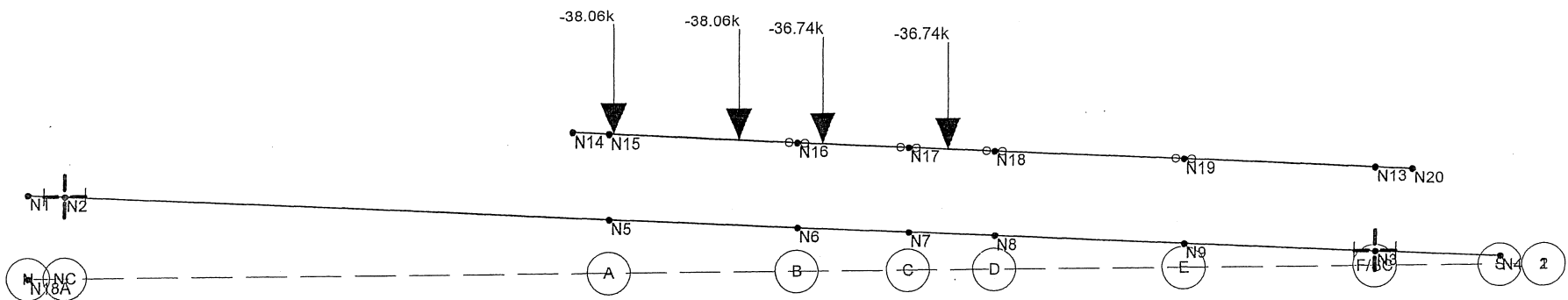
090147

Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:26 PM

090147_3A_P6_Pier.r3d

22-22



Loads: BLC 13, Mom Type 3S2-40 + SU7

LHB

jdf

090147

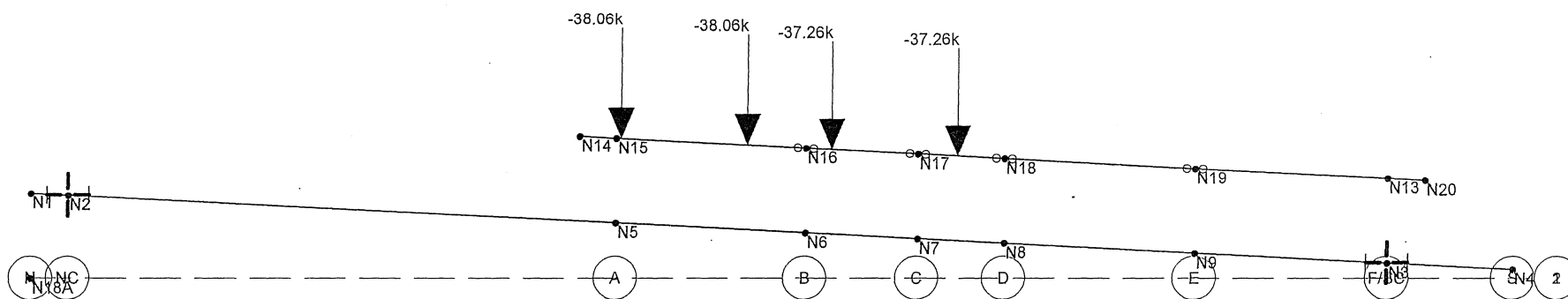
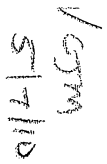
Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:26 PM

090147_3A_P6_Pier.r3d

10/10
5/10
01/10

7-23



Loads: BLC 14, Mom Type 3S3 + SU7

LHB

jdf

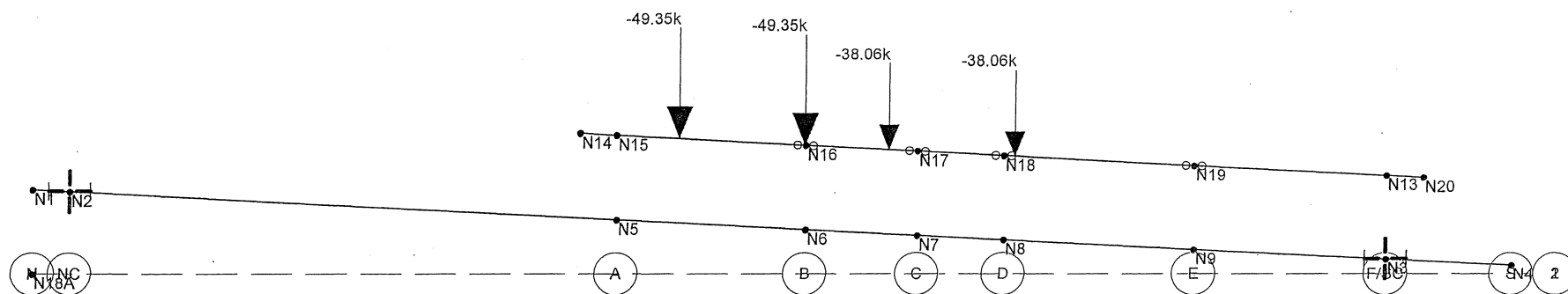
090147

Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:26 PM

090147_3A_P6_Pier.r3d

7.24



16.5m
5/7/10

Loads: BLC 15, Mom Std A + SU7

LHB

jdf

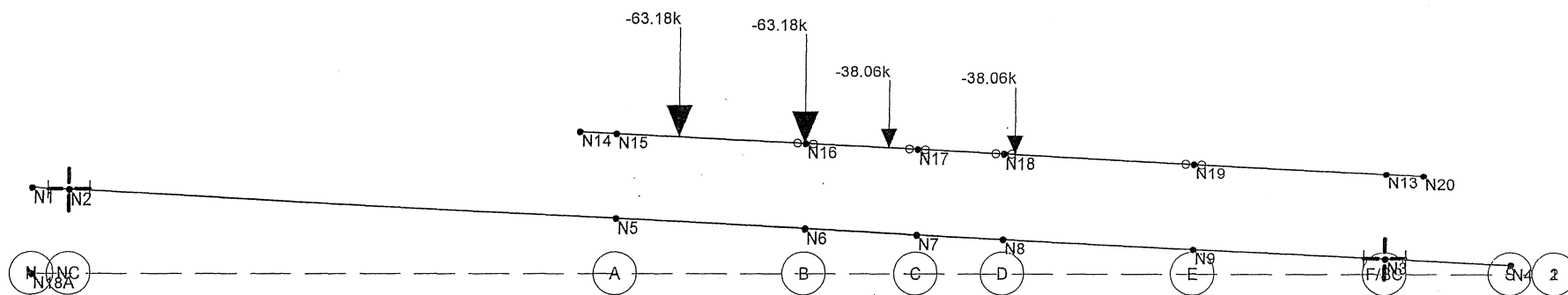
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Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:26 PM

090147_3A_P6_Pier.r3d

2-25

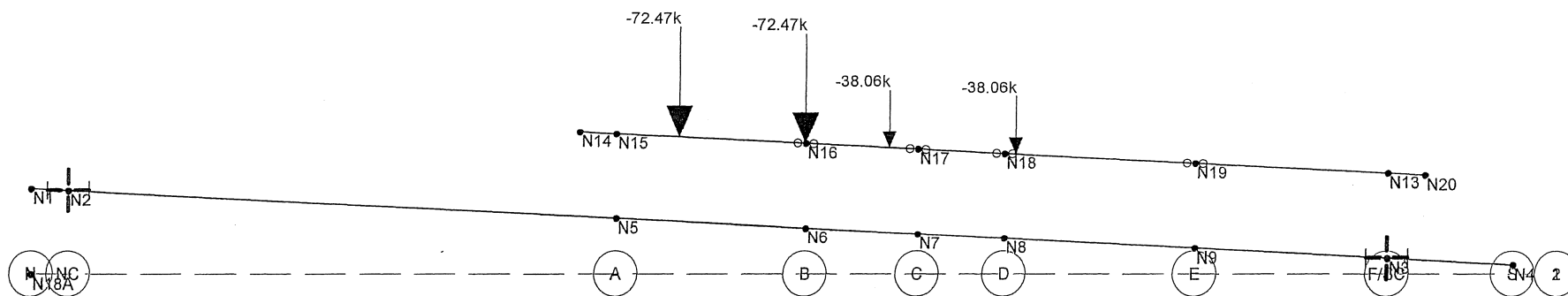


105M
5/7/10

Loads: BLC 16, Mom Std B + SU7

LHB	Bridge 69801 3A Pier 6	
jdf		Apr 19, 2010 at 2:26 PM
090147		090147_3A_P6_Pier.r3d

2-26



105m
5/7/10

Loads: BLC 17, Mom Std C +SU7

LHB

jdf

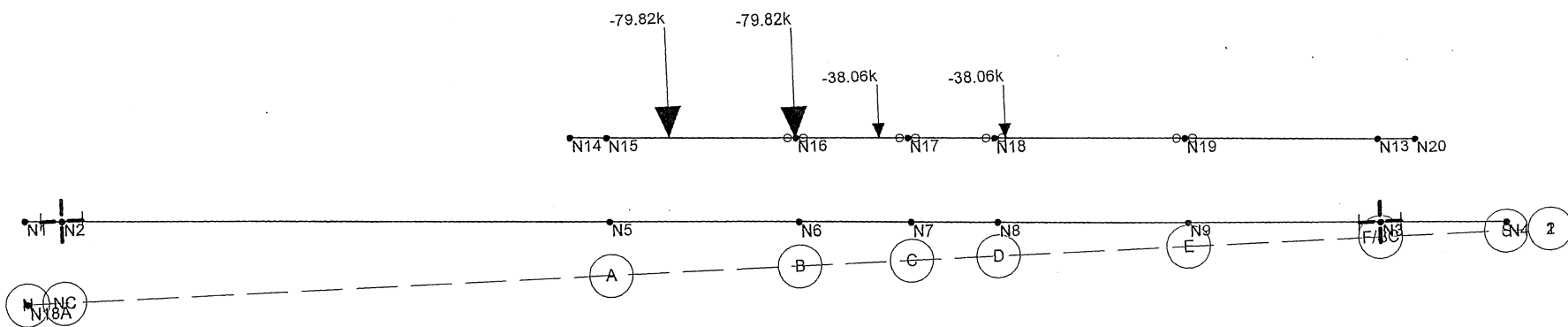
090147

Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:26 PM

090147_3A_P6_Pier.r3d

22-2



✓
CSM
SCH110

Loads: BLC 18, Mom P411 + SU7

LHB

jdf

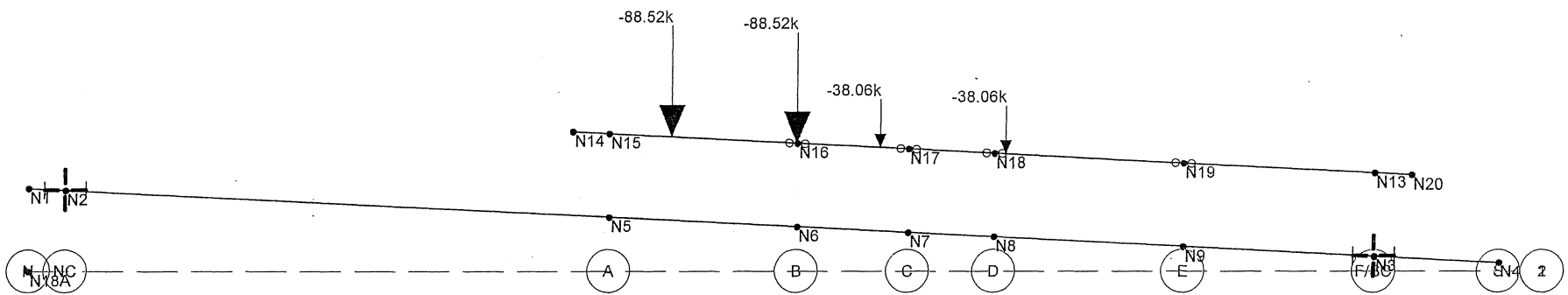
090147

Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:26 PM

090147_3A_P6_Pier.r3d

7-78



Loads: BLC 19, Mom P413 + SU7

LHB

jdf

090147

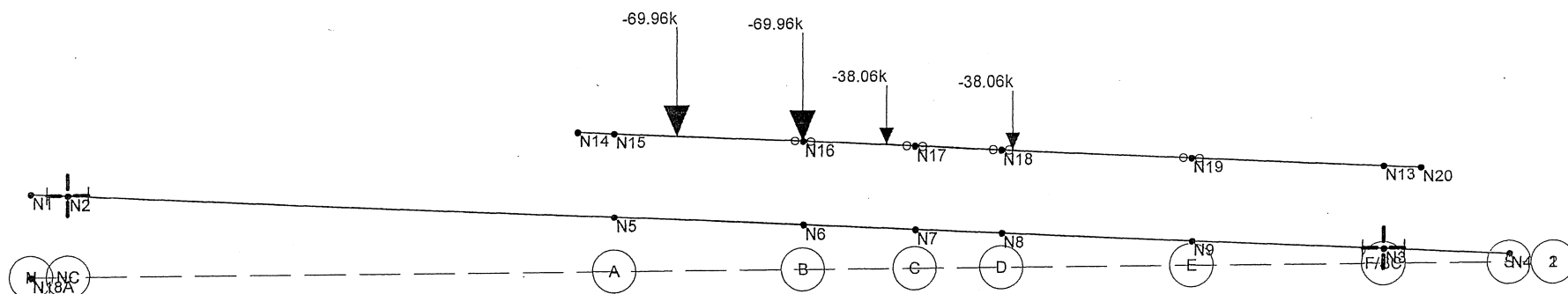
Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:26 PM

090147_3A_P6_Pier.r3d

VC3M
5/17/10

7-29



1057M
5-17-10

Loads: BLC 20, Mom Std C152b + SU7

LHB

jdf

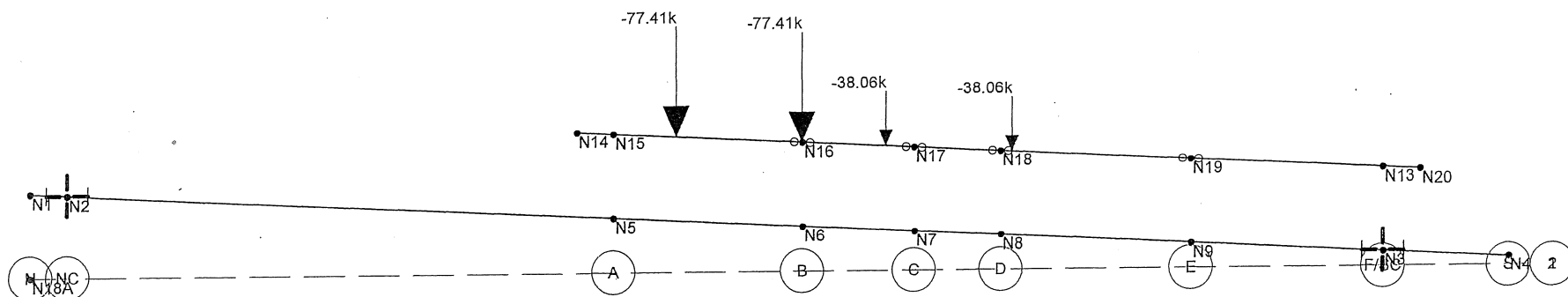
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Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:26 PM

090147_3A_P6_Pier.r3d

7-30



Loads: BLC 21, Mom Std C174b + SU7

LHB

jdf

090147

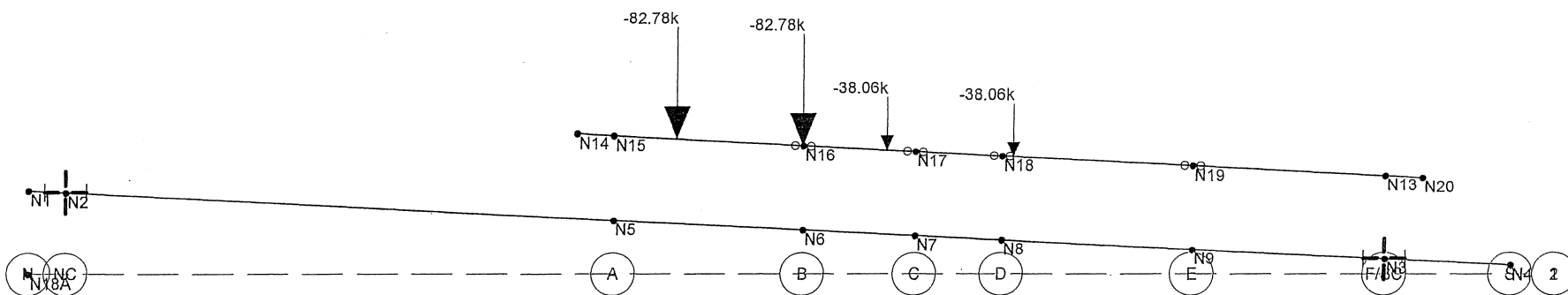
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Apr 19, 2010 at 2:26 PM

090147_3A_P6_Pier.r3d

165m
5/7/10
04/15

7-31



Loads: BLC 22, Mom Std C198_23 + SU7

LHB

jdf

090147

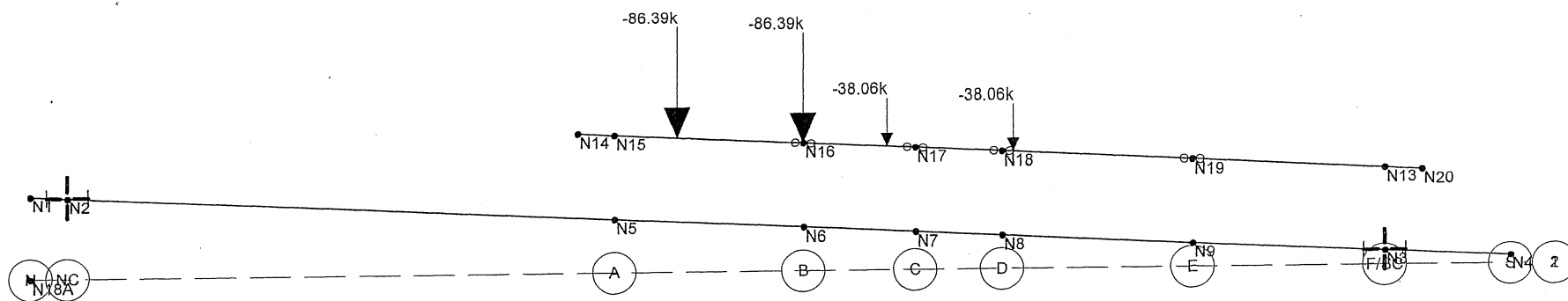
Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:27 PM

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VCSM
5/7/10

2-32



Loads: BLC 23, Mom Std 214b + SU7

Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:27 PM

090147_3A_P6_Pier.r3d

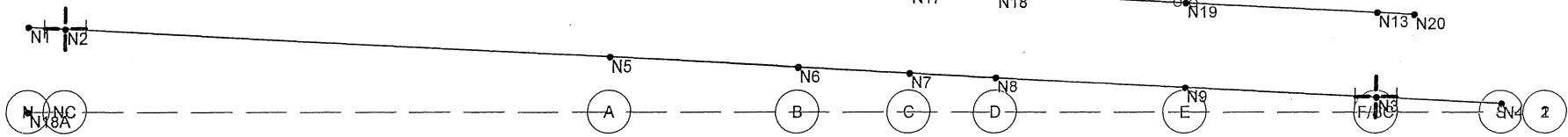
LHB

jdf

090147

105M
5/7/10

2-23

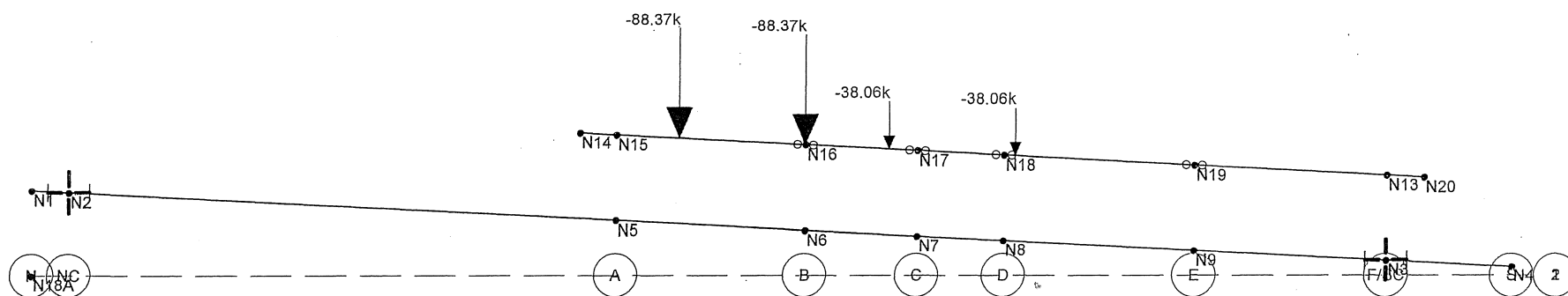


LHB
jdf
090147

Bridge 69801 3A Pier 6

090147_3A_P6_Pier.r3d

165m
5/7/10



Loads: BLC 25, Mom Std C256b + SU7

LHB

jdf

090147

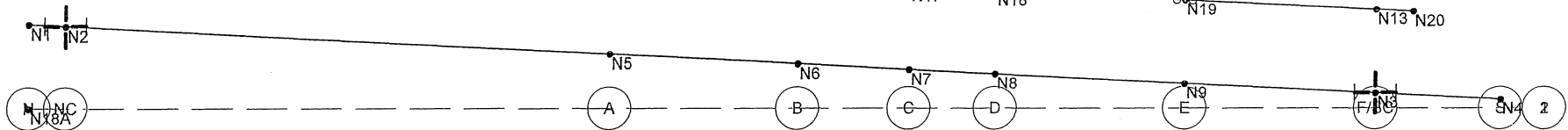
Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:27 PM

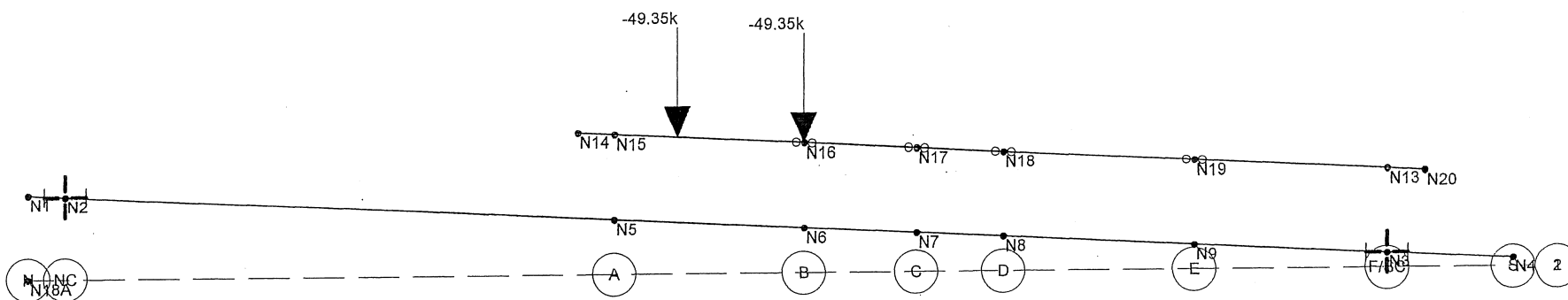
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163M
5/19/10

7-35



NCM
style



Loads: BLC 27, Mom Std A

LHB

jdf

090147

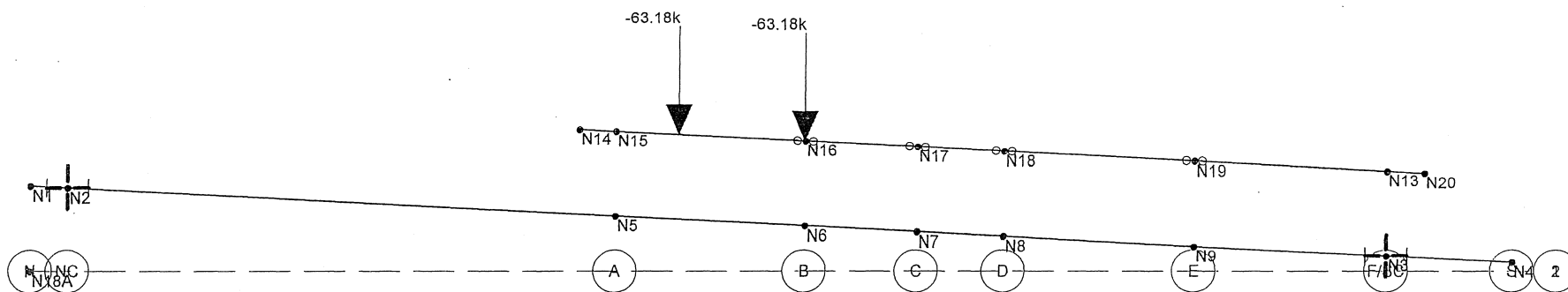
Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:27 PM

090147_3A_P6_Pier.r3d

VCM
5/7/10

7-37



105M
5/7/10

Loads: BLC 28, Mom Std B

LHB

jdf

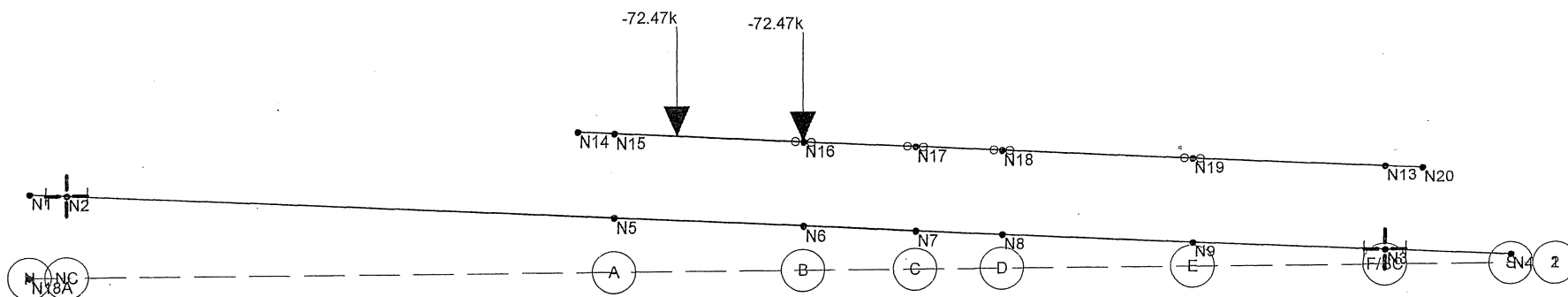
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Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:27 PM

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2-38



165m
5/7/10

Loads: BLC 29, Mom Std C

Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:27 PM

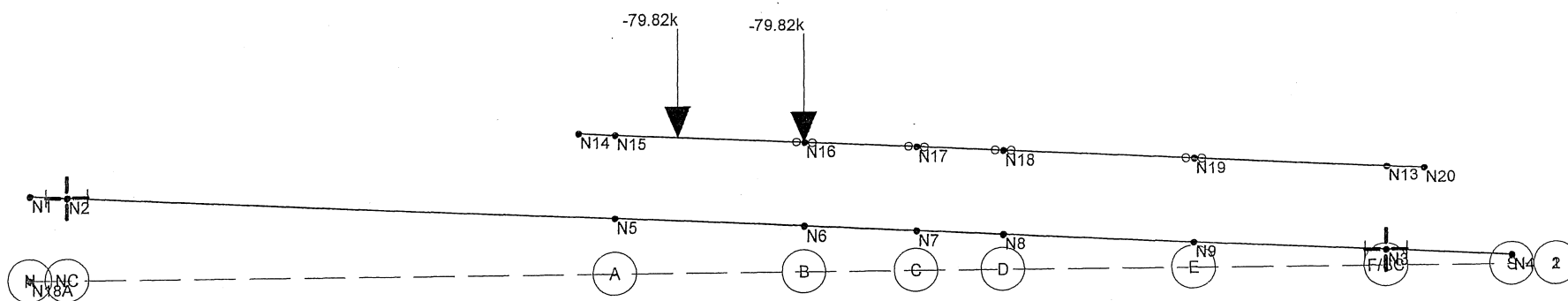
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LHB

jdf

090147

2-39



165m
5/7/10

Loads: BLC 30, Mom P411

Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:27 PM

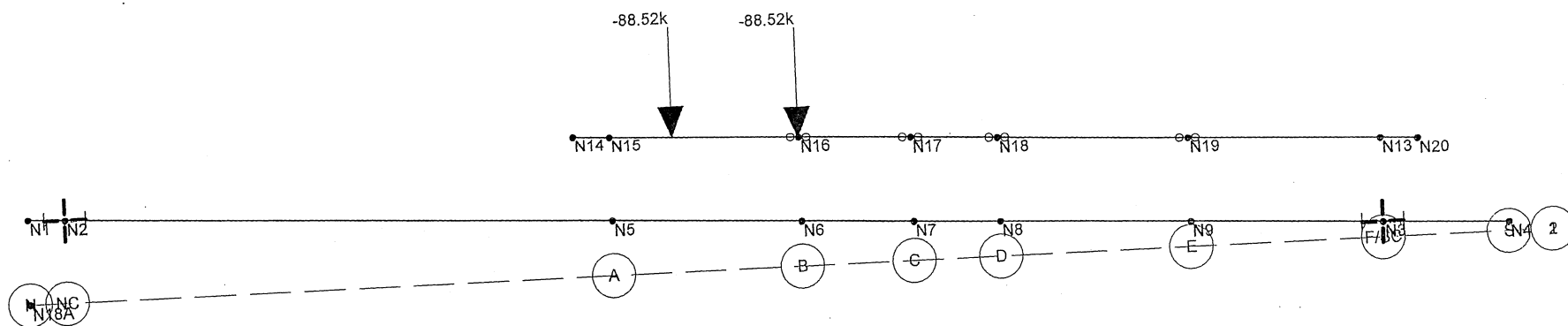
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LHB

jdf

090147

2-40



14-2
5/7/10
JCSM

Loads: BLC 31, Mom P413

LHB

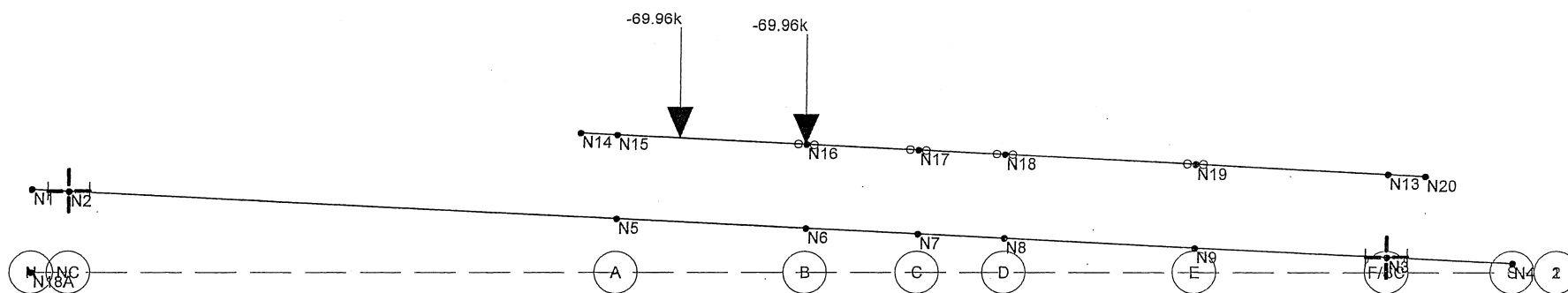
jdf

090147

Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:27 PM

090147_3A_P6_Pier.r3d



1/3/11
5/7/10

Loads: BLC 32, Mom Std C152b

LHB

jdf

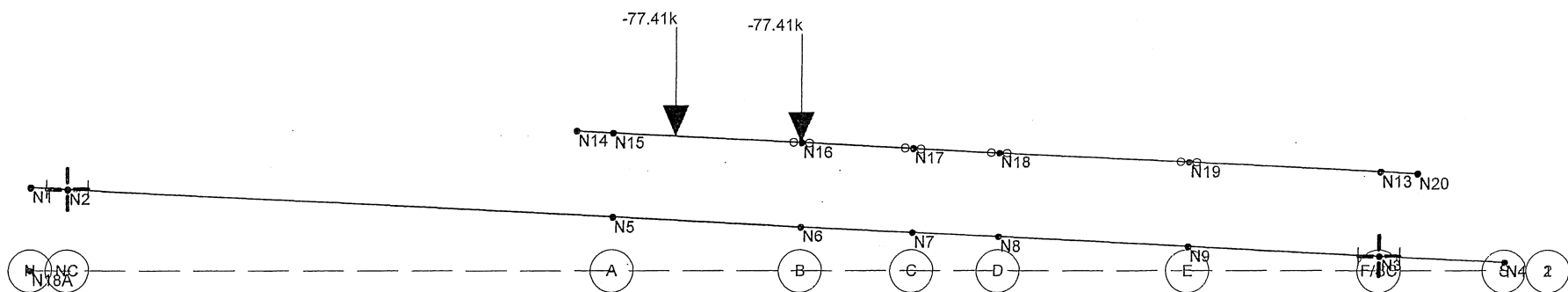
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Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:28 PM

090147_3A_P6_Pier.r3d

24-2



1/65m
5/17/10

Loads: BLC 33, Mom Std C174b

LHB

jdf

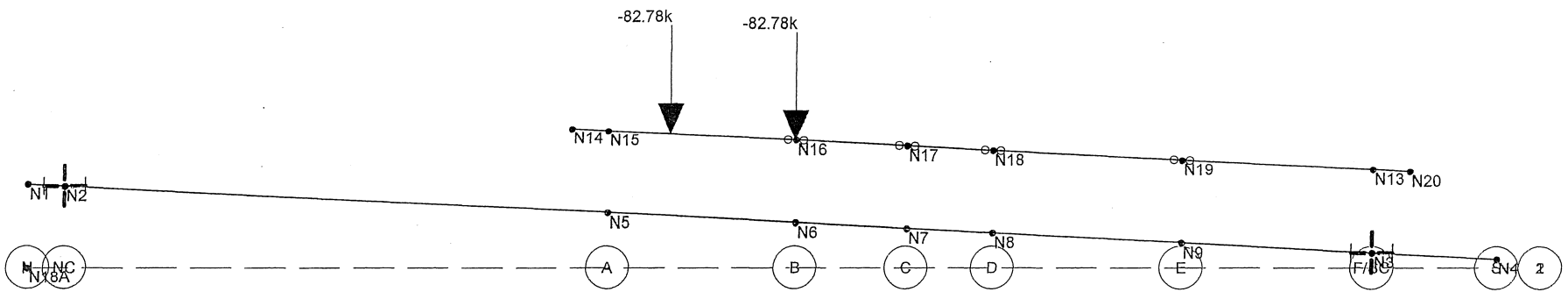
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Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:28 PM

090147_3A_P6_Pier.r3d

2-43



Loads: BLC 34, Mom Std C198_23

LHB

jdf

090147

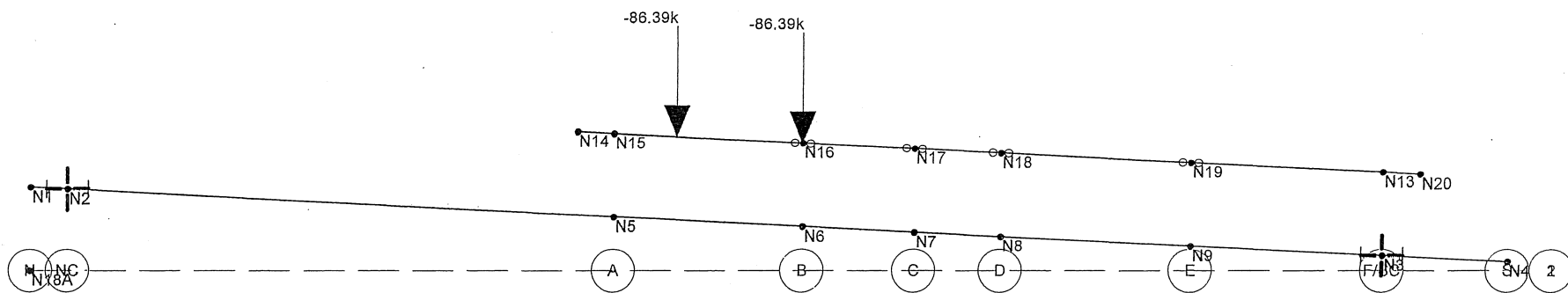
Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:28 PM

090147_3A_P6_Pier.r3d

16379
SHIP

2-44



161110
57110

Loads: BLC 35, Mom Std 214b

Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:28 PM

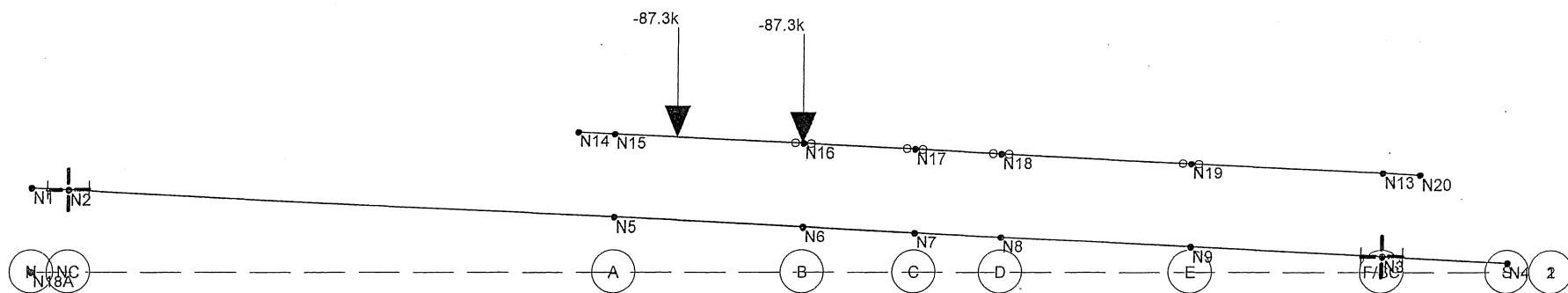
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LHB

jdf

090147

2-45



dcjm
5/7/10

Loads: BLC 36, Mom Std C237b

LHB

jdf

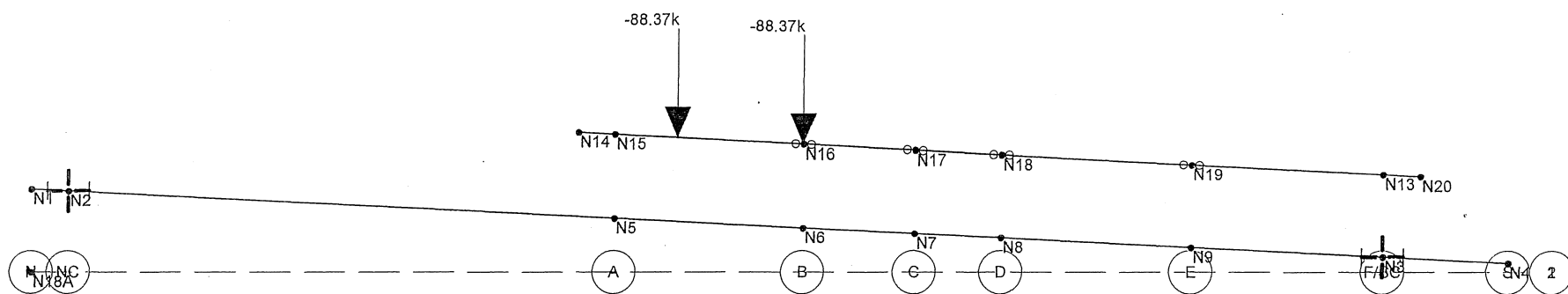
090147

Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:28 PM

090147_3A_P6_Pier.r3d

2.40



Loads: BLC 37, Mom Std C256b

LHB

jdf

090147

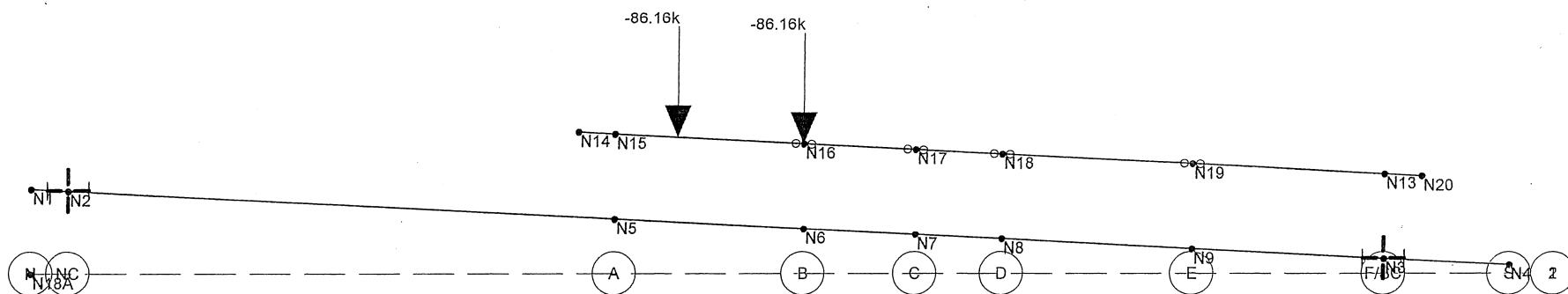
Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:28 PM

090147_3A_P6_Pier.r3d

5/7/10
VCSM

2-47

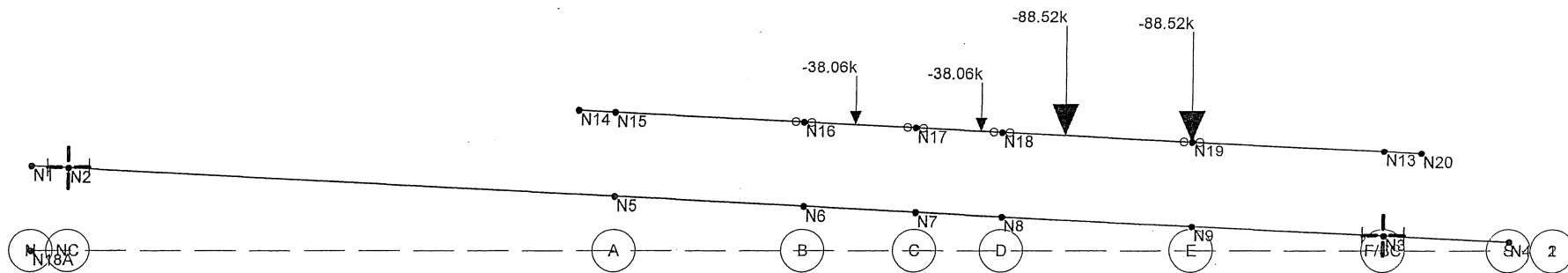


01/12/15
165m
57/110

Loads: BLC 38, Mom Std C200j

LHB	Bridge 69801 3A Pier 6	
jdf		Apr 19, 2010 at 2:28 PM
090147		090147_3A_P6_Pier.r3d

2-148



VC54
5/1/10

Loads: BLC 39, Shr P413 + SU7

LHB

jdf

090147

Bridge 69801 3A Pier 6

Apr 19, 2010 at 2:28 PM

090147_3A_P6_Pier.r3d

2-49

64801J-3A-P6
Model Results

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

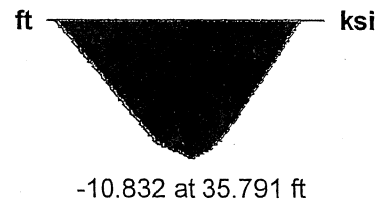
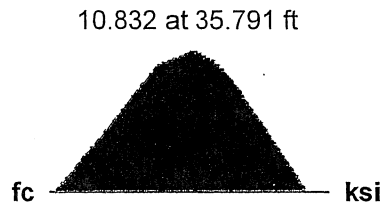
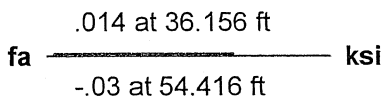
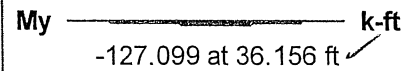
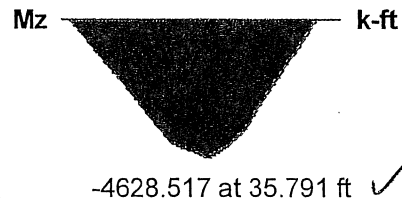
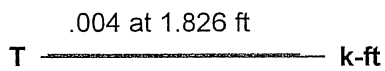
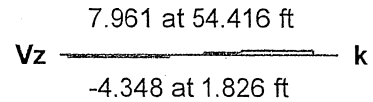
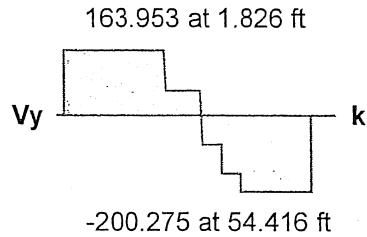
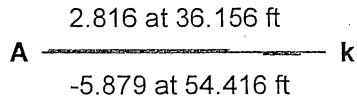
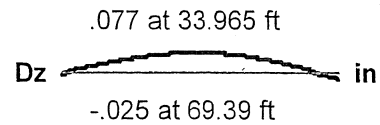
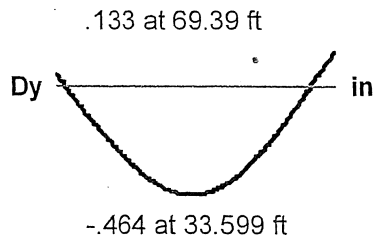
I Joint: **N1**

J Joint: **N4**

LC 1: **Max Moment**

Code Check: **0.000 (bending)**

Report Based On 191 Sections



ASMA
initial
to 57/10
reflect
6/24/10

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

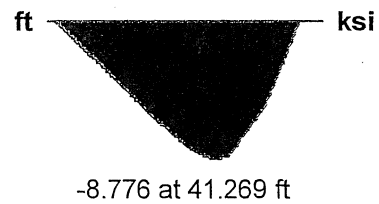
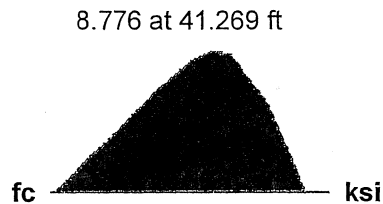
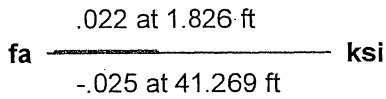
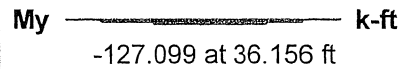
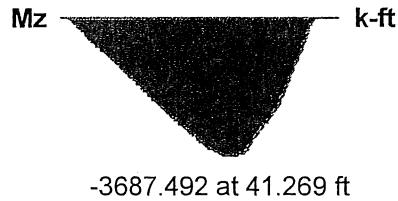
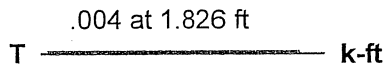
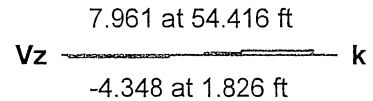
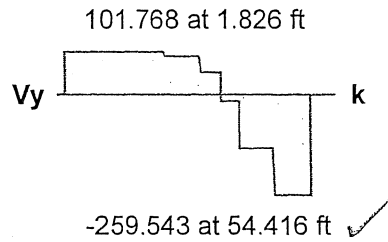
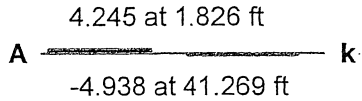
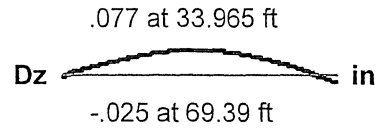
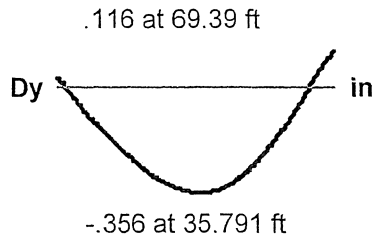
I Joint: **N1**

J Joint: **N4**

LC 2: **Max Shear**

Code Check: **0.000 (bending)**

Report Based On 191 Sections



✓CSM
initial
6/5/7/10
recheck
6/24/10

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

I Joint: **N1**

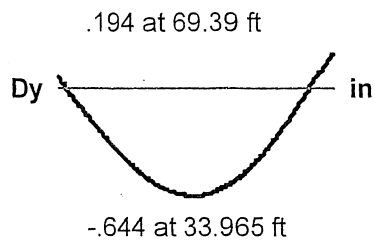
J Joint: **N4**

LC 3: All Dead Loads

Code Check: **0.000 (bending)**

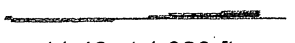
Report Based On 191 Sections

✓COM
initia
5/10/10
recte
6/24/10

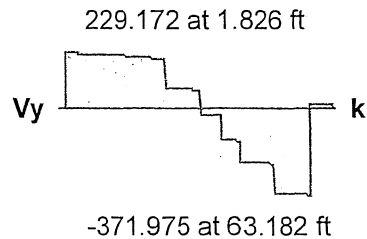


Dz _____ in

18.092 at 63.182 ft

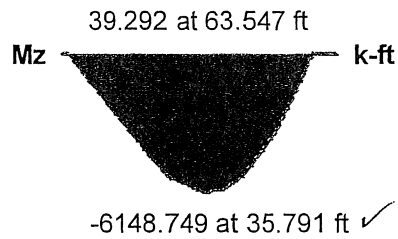
A  k

-11.46 at 1.826 ft



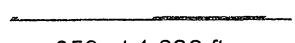
Vz _____ k

T _____ k-ft

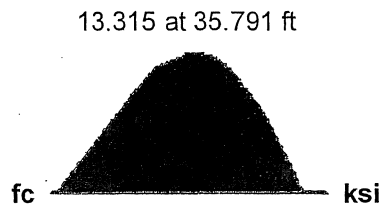


My _____ k-ft

.093 at 63.182 ft

fa  ksi

-.059 at 1.826 ft



ft  ksi

-13.315 at 35.791 ft

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

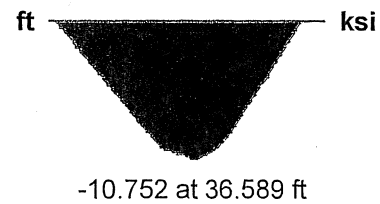
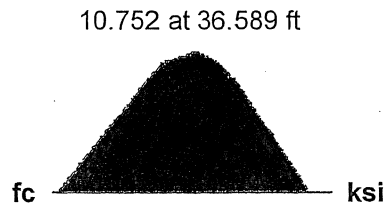
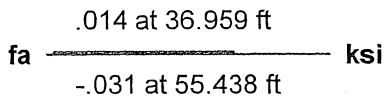
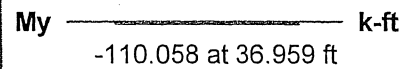
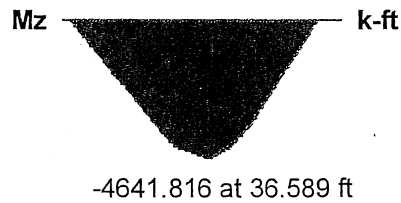
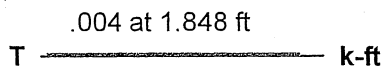
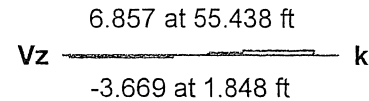
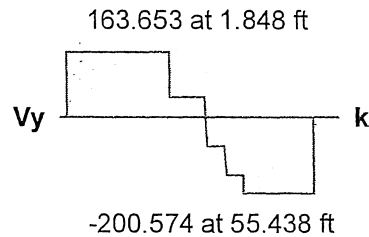
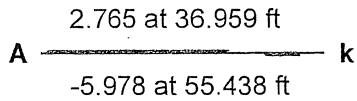
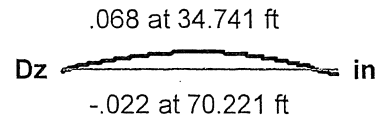
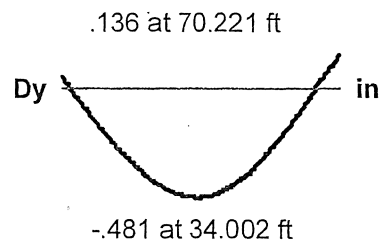
I Joint: **N1**

J Joint: **N4**

LC 1: Max Moment

Code Check: **0.000 (bending)**

Report Based On 191 Sections



S 5/21/10

AA-4

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

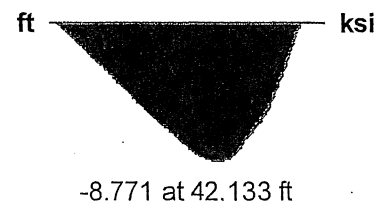
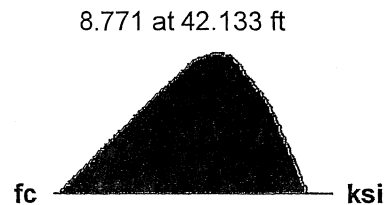
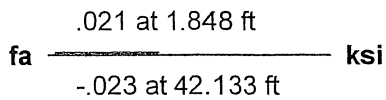
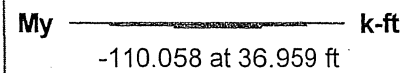
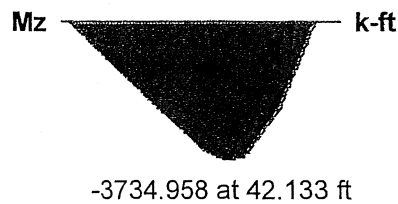
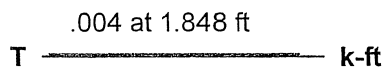
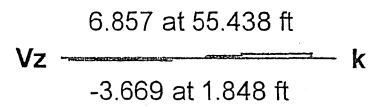
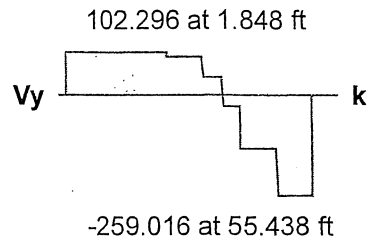
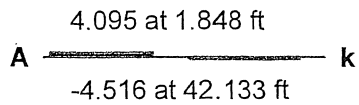
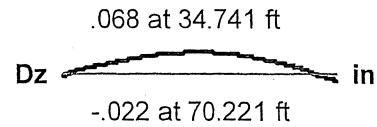
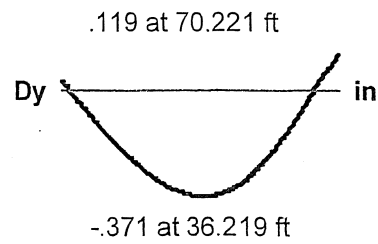
I Joint: **N1**

J Joint: **N4**

LC 2: **Max Shear**

Code Check: **0.000 (bending)**

Report Based On 191 Sections



S 5/21/10

AA-5

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

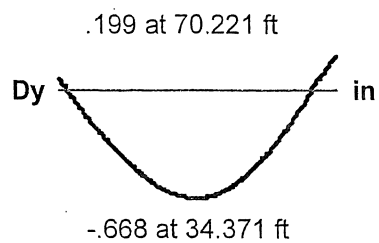
I Joint: **N1**

J Joint: **N4**

LC 3: All Dead Loads

Code Check: **0.000 (bending)**

Report Based On 191 Sections

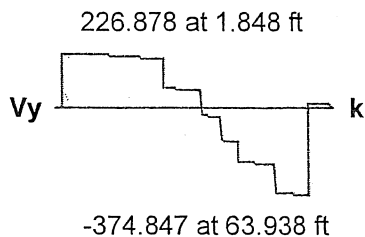


Dz _____ in

18.229 at 63.938 ft

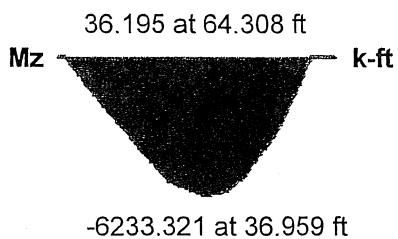
A _____ k

-11.335 at 1.848 ft



Vz _____ k

T _____ k-ft

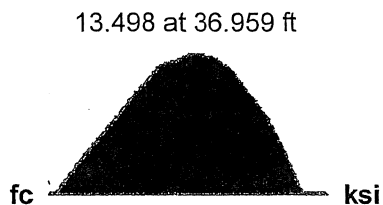


My _____ k-ft

.093 at 63.938 ft

fa _____ ksi

-.058 at 1.848 ft



S 5/21/10

AA-6



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PROJECT MnDOT SS-69801J-3A.P6 - Risa Results
PROJECT # 090147 DATE 4.19.10 BY jdf SHEET NO. _____ OF _____

Risa Results

LC 4: Moving L4 One Lane - Used when Reviewing One Lane Loading. Determined that 2 lane Loading controls. See Results for One Lane Loading before the Risa Input Printout.

LC 5 - LC 19: Posting and Permit trucks with 2 traffic lanes. See Posting / Permit Calculations.

LC 20 - LC 32: Posting and Permit trucks with 1 traffic lane. See Posting / Permit Calculations.

648010-5416
STRENGTH



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PROJECT MnDOT SS-69801J-3A-P6-Flexural Strength LRFD-1
PROJECT # 090147 DATE 1.27.10 BY jdP SHEET NO. ✓CSM OF 5116/12

Follow Article 6.10 in LRFD for I-shaped members.
Check provisions of 6.10.1 and 6.10.6

See 6.10.6 for Strength Limit States

See 6.10.6.2.3 for Non-composite Sections.

- $F_y = 36 \text{ ksi}$ OK ✓
- $\frac{2D_c}{t_w} = \frac{2 \times \frac{1}{2} \times 78}{\frac{1}{2}} = 156 < 5.7 \sqrt{\frac{E}{F_{yc}}} = 5.7 \sqrt{\frac{29000}{36}} = 161.8$ OK ✓
- $\frac{I_{xc}}{I_{yt}} = 1.0 \geq 0.3$ OK

Since these 3 provisions are met, proportion per Appendix A (Not 6.10.8) ✓

A6.1.1

$$M_u + \frac{1}{3} f_e S_{xc} \leq \phi_f m_{nc} \quad \checkmark$$

m_u varies, see Risa ✓

f_e = Flange Lateral Bending Stress, Article 6.10.1.6 ✓

Use first-order elastic analysis if:

$$L_b \leq 1.2 L_p \sqrt{\frac{C_b R_b}{m_u / m_{yc}}} \quad \checkmark$$

$$L_b = \text{unbraced length} = 25' - 13\frac{1}{16}" = 301.2' \quad \checkmark$$

$$L_p \Rightarrow \text{Article 6.10.8.2.3}$$

$$= 1.0 C_e \sqrt{E / F_{yc}} \quad \checkmark$$

BB-1



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PROJECT MnDOT SS-69801 J-3A-P6- Flexural Strength LRFD - 2
PROJECT # 090147 DATE 1.27.10 BY jdj SHEET NO. 5/10/10 OF 10

$$r_t = \frac{b_{fc}}{\sqrt{12 \left(1 + \frac{1}{3} \frac{D_c + t_w}{b_{fc} t_c} \right)}} = \frac{39}{\sqrt{12 \left(1 + \frac{1}{3} \frac{39 \times \frac{1}{2}}{39 \times 1\frac{1}{2}} \right)}} = 10.68" \checkmark (\text{conservative})$$

$$L_p = 1.0 \times 10.68 \sqrt{\frac{29000}{36}} = 303.1" \checkmark$$

$C_b \Rightarrow$ See A6.3.3, Use 1.0 (conservative)

$R_b \Rightarrow$ See 6.10.1, 10.2

$$\text{Since } \frac{2D_c}{t_w} = 156 \leq \lambda_{rw} = 161.8 \checkmark, R_b = 1.0$$

Assume $m_u/m_y = 1.00$ (conservative)

$$L_b = 195" \leq 1.2 \times 303.1 \sqrt{\frac{1.0 \times 1.0}{1.0}} = 363.7 \checkmark \therefore \text{use first-order analysis}$$

$$f_g = \frac{m_u}{S_y}$$

m_u varies, see Risa
 $S_y = 1882.83 \text{ in}^3 \checkmark$

$$S_{xc} = S_x = 5541.61 \text{ in}^3 \checkmark$$

$\phi_f = 1.0$ for flexure $\checkmark$

$M_{nc} \Rightarrow$ See A6.3 $\Rightarrow$ Smaller of A6.3.2 + A6.3.3

A6.3.2 Local Buckling Resistance

does $\lambda_f \leq \lambda_{pf}$?

BB-2



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PROJECT MnDOT SS-69801 J-3A-P6-Flexural Strength LRFD-3

PROJECT # 090147 DATE 1.28.10 BY jdf SHEET NO. OF

$$\lambda_f = \frac{b_{fc}}{2t_{fc}} = \frac{39}{2 \times 1\frac{1}{2}} = 13 \checkmark$$

$$\lambda_{pf} = 0.38 \sqrt{E/F_{yc}} = \text{limiting slenderness ratio for a compact flange (I-section)}$$

We should use the limit for an HSS section
See AISI

$$\lambda_{pf} \Rightarrow \text{between webs} = 1.12 \sqrt{E/F_{yc}} = 1.12 \sqrt{29000/36} = 31.8$$

Compare to $b/t = 33/1.5 = 22 \checkmark$ OK

$$\lambda_{pf} \Rightarrow \text{flange overhang} = 0.38 \sqrt{E/F_{yc}} = 10.79$$

Compared to $\frac{b}{t} = 3/1.5 = 2 \checkmark$ OK

Compact Flange, use A6.3.2-1

$$M_{nc} = R_{pc} M_{yc} \checkmark$$

R_{pc} = web plastification factor, see A6.2.1 or A6.2.2.

If compact web use A6.2.1 otherwise A6.2.2.

$$\text{Compact if: } \frac{2D_{cp}}{t_w} \leq \lambda_{pw}(D_{cp})$$

$$D_{cp} = \frac{1}{2} \times 78" = 39" \checkmark$$

$$t_w = \frac{1}{2}" \checkmark$$

$$\lambda_{pw}(D_{cp}) = \frac{\sqrt{E/F_{yc}}}{\left(0.54 \frac{M_p}{R_h M_y} - 0.01\right)^2} \leq \lambda_{rw} \left(\frac{D_{cp}}{D_c}\right)$$

$$M_p = F_y Z_x = 36 \text{ ksi} \times 6171.75 \text{ in}^3 = 222183 \text{ kip-in}$$

$$M_y = F_y S_x = 36 \text{ ksi} \times 5541.61 \text{ in}^3 = 199498 \text{ kip-in}$$

$$R_h = 1.0 \text{ since homogeneous, see 6.10.1.10.1}$$

$$\lambda_{rw} = 5.7 \sqrt{E/F_y} = 161.8 \checkmark$$

$$D_c = \frac{1}{2} \times 78" = 39" \checkmark$$

BB-3



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PROJECT MnDOT SS-69801 J - 3A-P6-Flexural Strength LRFD - 4
PROJECT # 090147 DATE 1.28.10 BY jdf [✓] _{5/10/10} SHEET NO. _____ OF _____

$$\lambda_{pw(Dcp)} = \frac{\sqrt{29000/36}}{\left(0.54 \times \frac{222183}{1.0 \times 199498} - 0.09\right)^2} = 108.5 \quad \checkmark$$

$$\leq 161.8 \left(\frac{39}{34}\right) = 161.8 \quad \checkmark$$

$$\lambda_{pw(Dcp)} = 108.5 \quad \checkmark$$

$$\frac{2 D_{cp}}{t_w} = \frac{2 \times 39}{1/2} = 156 > \lambda_{pw(Dcp)} = 108.5 \quad \checkmark$$

not compact
go to A6.2.2.

A6.2.2, check if $\lambda_w < \lambda_{rw}$

$$\lambda_w = \frac{2 D_c}{t_w} = \frac{2 \times 39}{1/2} = 156 \quad \checkmark$$

$$\lambda_{rw} = 5.7 \sqrt{E/F_{yc}} = 161.8 \quad \checkmark$$

Since $\lambda_w < \lambda_{rw}$ we are noncompact use
A6.2.2-4.

$$R_{pc} = \left[1 - \left(1 - \frac{R_h m_{yc}}{m_p}\right) \left(\frac{\lambda_w - \lambda_{pw(Dc)}}{\lambda_{rw} - \lambda_{pw(Dc)}}\right)\right] \frac{m_p}{m_{yc}} \leq \frac{m_p}{m_{yc}}$$

$$\lambda_{pw(Dc)} = \lambda_{pw(Dcp)} \left(\frac{D_c}{D_{cp}}\right) = 108.5 \times \frac{39}{34} = 108.5 \quad \checkmark$$

$$R_{pc} = \left[1 - \left(1 - \frac{1.0 \times 199498}{222183}\right) \left(\frac{156 - 108.5}{161.8 - 108.5}\right)\right] \frac{222183}{199498} \leq \frac{222183}{199498}$$

$$= 0.909 \times 1.1137 = 1.012 \leq 1.1137$$

$$R_{pc} = 1.012 \quad \checkmark$$

$$R_{pt} = R_{pc} = 1.012 \quad \checkmark$$

BB-4



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PROJECT MnDOT SS-69801J-3A-P6 - Flexural Strength LRFD - 5

PROJECT # 09D147 DATE 1.28.10 BY jdf [✓] 5/10/10 SHEET NO. _____ OF _____

$$M_{nc} = 1.012 \times 199498 = 201892 \text{ kip}\cdot\text{in per A6.3.2}$$

M_{nc} per A6.3.3: Lateral Torsional Buckling Resistance.

Check if $L_b < L_p$, then $M_{nc} = R_{pc} M_{yc}$.

$$L_b = 195' \quad \checkmark$$

$$L_p = 303.1' \quad \checkmark$$

$$L_b < L_p \therefore M_{nc} = R_{pc} M_{yc}$$

$$M_{nc} = 1.012 \times 199498 = 201892 \text{ kip}\cdot\text{in per A6.3.3}$$

$$M_{nc} = 201892 \text{ kip}\cdot\text{in} \quad \checkmark$$

Tension Flange Yielding A6.4

$$M_{nt} = R_{pt} M_{yt}$$

$$R_{pt} = 1.012, \text{ see pg 4} \quad \checkmark$$

$$M_{yt} = M_{yc} = 199498 \text{ kip}\cdot\text{in} \quad \checkmark$$

$$M_{nt} = 1.012 \times 199498 = 201892 \text{ kip}\cdot\text{in} \quad \checkmark$$

Project: MnDOT Special Structures - 69801J - Bridge 3A Pier 6
 Date: 21-May-10
 RisaSection Name: BR3A-P6-1

Project Number: 90147
 Eng: JDF
 Checked By: CSM

initial check 5/10/10
 recheck 6/24/10

Spreadsheet has been created for use with Box Steel Beam Caps Only.
 For sections with compact, non-compact, or slender flanges.
 For sections with compact or non-compact webs.

Yield Strengths:	Fyc:	36 ksi	Fyt:	36 ksi	Fyw:	36 ksi
Modulus of Elasticity:	E:	29000 ksi				
Compression Flange:	bfc:	39 in	tf:	1.5 in		
Tension Flange:	btf:	39 in	tt:	1.5 in		
Webs:	D:	78 in	tw:	0.5 in		
Clear Space between webs:		33 in				
Unbraced Length:	Lb:	301.2 in				
Neutral Axis:	Y-bar (Comp)	40.5 in	Y bar (Ten)	40.5 in	X-bar	19.5 in
Moment of Intertia:	Ixx	224400 in^4	Iyy	36720 in^4	Sy	1882.83 in^3
Section Modulus:	Sx (Comp)	5541.6 in^3	Sx (Ten)	5541.6 in^3		
Radius:	rx	33.926 in	ry	13.722 in		
Plastic Modulus:	Zx	6171.75 in^3	Zy	2447.25 in^3		
Torsional Constant:	J	92.61 in^4				

Based on AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition, 2007, With 2008 & 2009 Interim Revisions

Article 6.10 - I-Section Flexural Members

Article 6.10.6 - Strength Limit State

Article 6.10.6.2 - Flexure

Article 6.10.6.2.3 - Composite Sections in Negative Flexure and Noncomposite Sections

If the following conditions are met, proportion the section according to the provisions for compact or noncompact web sections specified in Appendix A. Otherwise, the section shall be proportioned according to provisions specified in Article 6.10.8.

Depth of Web in Comp:	Dc:	39 in
Moment of Inertia Comp Flange:	Iyc:	7414.9 in^4
Moment of Inertia Tens Flange:	Iyt:	7414.9 in^4

Yield Strength Limit:	Max Fy:	36 ksi	Limit Fy:	70 ksi	OK - Keep Going
Web Slenderness Limit (slender):	2*Dc/tw:	156	5.7*(E/Fyc)^.5:	161.8 ksi	OK - Keep Going
Flange Ratio:	Iyc/Iyt:	1	Limit:	0.3	OK - Keep Going

Appendix A6: Flexural Resistance of Straight Composite I-Sections in Negative Flexure and Straight Non-composite I-sections with Compact or Noncompact Webs

Article A6.1 - General - Same as Article 6.10.6.2.3 above.

Article A6.1.1 - Sections with Discretely Braced Compression Flanges

At the limit state the following requirement shall be satisfied: $M_u + (1/3) * f_l * S_{xc} \leq \phi(f) * M_{nc}$

Bending Moment - Major Axis:	Mu:	Varies, see Risa 3D
Flange Lateral Bending Stress:	fi:	See Article 6.10.1.6

Flange lateral bending stress, f_l , may be determined directly from first-order elastic analysis in discretely braced compression flanges for which: $b \leq 1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{.5}$

Limiting Unbraced Length:	Lp:	See Article 6.10.8.2.3
	Lp:	$1.0 * r_t * (E / F_{yc})^{.5}$
Effective Radius of Gyration:	rt:	$b_{fc} / (12 * (1 + (1/3) * (D_c * tw / (b_{fc} * t_{fc}))))^{.5}$
	rt:	10.7 in
	Lp:	303.1 in

Moment Gradient Modifier:	Cb:	See Article 6.10.8.2.3 or Article A6.3.3, as applicable
	Cb:	1 Since $M_{mid} / M_2 > 1$ at most situations. May be conservative at some locations.

Web Load-shedding Factor:	Rb:	See Article 6.10.1.10.2 1.0 if $2 * D_c / tw \leq \lambda_{md} (rw)$
Web Slenderness Limit (noncompact):	$\lambda_{md} (rw)$:	$5.7 * (E / F_{yc})^{.5}$ 161.8
	$2 * D_c / tw$:	156
	Rb:	1

Major Axis Bending to Yield Moment:	M_u / M_{yc} :	1 Assume 1.0. Conservative.
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Unbraced Limit for fl:	Lb:	301.2 in	$1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{.5}$	363.8 in	OK - Keep Going, First-order elastic analysis
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Flange Lateral Bending Stress:	fi:	M_{uy} / S_y First-order elastic analysis
Factored Weak Axis Bending Moment:	Muy:	See Risa

Resistance Factor for Flexure:	$\phi(f)$:	1 As specified in Article 6.5.4.2
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Nominal Flexural Resistance:	Mnc:	See Article A6.3
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Nominal Flexural Resistance based on compression flange, M_{nc} , shall be taken as the smaller of the local buckling resistance determined as specified in Article A6.3.2, and the lateral torsional buckling resistance determined as specified in Article A6.3.3.

Article A6.3.2 - Local Buckling Resistance:

Determine if the compression flange is compact:

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Limiting Slenderness Ratio for Compact Flange: Use two ratios, one for the flange between the webs, and the other for the flange overhang. See AISC Table B4.1.

Case 12: Uniform compression in flanges of rectangular box and hollow structural sections of uniform thickness subject to bending or compression.

lamda(f)	b/t:	22.00	Clear space between webs/t _{fc}
lamda(pf)	$1.12 \cdot (E/F_y)^{0.5}$:	31.79	
lamda(rf)	$1.40 \cdot (E/F_y)^{0.5}$:	39.74	

Case 12: Compact Flange

Case 2: Flexure in flanges of doubly and singly symmetric I-shaped built-up sections.

lamda(f)	b/t:	1.83	Flange over hang measured from mid-web/t _{fc}
lamda(pf)	$0.38 \cdot (E/F_y)^{0.5}$:	10.79	
lamda(rf)	$0.95 \cdot (E \cdot k_c / F_y)^{0.5}$:	19.07	

k_c: $4 / (D/t_w)^{0.5}$: 0.32 but $0.35 \leq k_c \leq 0.76$
k_c: 0.35

F_{yr}: smaller of 3 items below:

0.7 · F _{yc} :	25.2 ksi
R _h · F _{yt} · S _{xt} / S _{xc} :	36.0 ksi
F _{yw} :	36.0 ksi
but not less than:	
0.5 · F _{yc} :	18.0 ksi

F_{yr}: 25.2 ksi

Case 2: Compact Flange

If Case 2 Flange is Noncompact or Slender, then check lamdas used.

Compression Flange:

Compact Flange Worse condition of Case 12 and Case 2

Nominal Flexural Resistance:

M_{nc}: M_{nc} = R_{pc} · M_{yc}

Equation A6.3.2-1 or A6.3.2-2

Web Plastification Factor - Comp:

R_{pc}: See Article A6.2.1 or A6.2.2, as applicable

Article A6.2.1 - Compact Web Sections:

Determine if the web is compact:

Compact if $2 \cdot D_{cp} / t_w \leq \lambda_{Dcp}$ (pw(Dcp))

Depth of Web in Comp at Plastic Mom:

D_{cp}: See Article D6.3.2

For non composite sections where: $F_{yw} \cdot A_w \geq [F_{yc} \cdot A_c - F_{yt} \cdot A_t]$, $D_{cp} = D / (2 \cdot A_w \cdot F_{yw}) [F_{yt} \cdot A_t + F_{yw} \cdot A_w - F_{yc} \cdot A_c]$, otherwise $D_{cp} = D$.

F_{yw} · A_w: 2808 kip | F_{yc} · A_c - F_{yt} · A_t: 0 kip

Use 2 · D · t_w for A_w due to two webs

D_{cp}: 39.0 in

Limiting Slenderness Ratio for Compact Web:

lamda (pw(Dcp)): $((E/F_y)^{0.5}) / (0.54 \cdot (M_p / (R_h \cdot M_y)) - 0.09)^{0.2} \leq \lambda_{Dcp}$ (rw) · (D_{cp} / D_c)
M_p: See Article D6.1

Plastic Moment

Article D6.1 - Plastic Moment:

M_p: See Table D6.1-2, Case I

M_p: $P_w / (2 \cdot D) \cdot [Y(\bar{y})^2 + (D - Y(\bar{y}))^2] + [P_{rt} \cdot d_{rt} + P_{rb} \cdot d_{rb} + P_t \cdot d_t + P_c \cdot d_c]$

Y($\bar{y}$): $(D/2) \cdot [(P_c - P_{rt} - P_{rb}) / P_w + 1]$

P_c: F_{yc} · b_c · t_c: 2106 kip

P_t: F_{yt} · b_t · t_t: 2106 kip

P_{rt}: 0 no concrete reinforcing steel

P_{rb}: 0 no concrete reinforcing steel

P_w: F_{yw} · D · t_w · 2: 2808 kip

This is multiplied by 2 due to two webs

Y($\bar{y}$): 39

d_{rt}: 0 no concrete reinforcing steel

d_{rb}: 0 no concrete reinforcing steel

d_t: Y($\bar{y}$) + t_t / 2: 39.75 in

d_c: D - Y($\bar{y}$) + t_c / 2: 39.75 in

M_p: 222183 kip-in

Hybrid factor:

R_h: See Article 6.10.1.10.1

R_h: 1

Yield Moment

M_y: Smaller of M_{yc} and M_{yt}, See Article D6.2.

M_{yc}: F_{yc} · S_{xc}: 199498 kip-in

M_{yt}: F_{yt} · S_{xt}: 199498 kip-in

M_y: 199497.6 kip-in

lamda (pw(Dcp)): smaller of

$((E/F_y)^{0.5}) / (0.54 \cdot (M_p / (R_h \cdot M_y)) - 0.09)^{0.2}$: 108.5

lamda(rw) · (D_{cp} / D_c): 161.8

lamda (pw(Dcp)): 108.5

Web Compact?

2 · D_{cp} / t_w: 156.0

lamda (pw(Dcp)): 108.5

Web is not compact, See Article A6.2.2

Web Plastification Factor - Comp: R_{pc}: M_p / M_{yc}: 1.114

Article A6.2.2 - Noncompact Web Sections

Verify the webs are non-compact and not slender.

If lamda(w) < lamda(rw), then noncompact.

Slenderness ratio for web: lamda(w): 2 · D_c / t_w: 156

Limiting Slenderness ratio for noncompact web:

lamda(rw): $5.7 \cdot (E/F_y)^{0.5}$: 161.8

Noncompact vs Slender webs?

Noncompact, keep going

Web Plastification Factor - Comp:

R_{pc}: smaller of

$[1 - (1 - R_h \cdot M_{yc} / M_p)] \cdot ((\lambda(w) - \lambda_{Dcp}) / (\lambda(rw) - \lambda_{Dcp})) \cdot (M_p / M_{yc})$

Limiting Slenderness ratio for a compact web:

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6/24/10

$\lambda(pw(Dc))$: smaller of $\lambda(pw(Dcp)) * (Dc/Dcp)$
 $\lambda(rw)$
 $\lambda(pw(Dcp)) * (Dc/Dcp)$ 108.5
 $\lambda(pw(Dc))$: 108.5
 $[1 - (1 - (R_h * Myc / Mp)) * ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] * (Mp / Myc)$ 1.012
Mp/Myc 1.114

Rpc: 1.012 Use if Web is Noncompact

Web Plastification Factor Comp: Rpc (FINAL): 1.012

Nominal Flexural Resistance - comp: Mnc: 201959 kip-in Per Article A6.3.2

Article A6.3.3 - Lateral Torsional Buckling Resistance:

If $L_b \leq L_p$, then $M_{nc} = R_{pc} * Myc$
 $L_b \leq L_p$, therefore $M_{nc} = R_{pc} * Myc$ (Same as A6.3.2)
Mnc: 201959 kip-in Per Article A6.3.3

Nominal Flexural Resistance - Comp: Mnc: 201959 kip-in

A6.4 - Flexural Resistance Based on Tension Flange Yielding

Nominal Flexural Resistance - tension: Mnt: $R_{pt} * Myt$

Web Plastification Factor - Ten: Rpt: See Article A6.2.1 or Article A6.2.2 as applicable.

Article A6.2.1 - Compact Web Sections
Rpt: Mp/Myt 1.114 Use if Web is Noncompact

Article A6.2.2 - Noncompact Web Sections
Rpt: smaller of $[1 - (1 - (R_h * Myt / Mp)) * ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] * (Mp / Myt)$
Mp/Myt
 $[1 - (1 - (R_h * Myt / Mp)) * ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] * (Mp / Myt)$ 1.012
Mp/Myt 1.114
Rpt: 1.012 Use if Web is Noncompact

Rpt (FINAL): 1.012

Nominal Flexural Resistance - Ten: Mnt: 201959 kip-in

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Project: MnDOT Special Structures - 69801J - Bridge 3A Pier 6
 Date: 4-Feb-10
 RisaSection Name: BR3A-P6-1

Project Number: 90147
 Eng: JDF
 Checked By:

Spreadsheet has been created for use with Box Steel Beam Caps Only.
 For sections with compact, non-compact, or slender flanges.
 For sections with compact or non-compact webs.

Yield Strengths:	F _{yc} :	36 ksi	F _{yt} :	36 ksi	F _{yw} :	36 ksi
Modulus of Elasticity:	E:	29000 ksi				
Compression Flange:	b _{fc} :	39 in	t _{fc} :	1.5 in		
Tension Flange:	b _{tc} :	39 in	t _{tc} :	1.5 in		
Webs:	D:	78 in	tw:	0.5 in		
Clear Space between webs:		33 in				
Unbraced Length:	L _b :	301.2 in				
Neutral Axis:	Y-bar (Comp)	40.5 in	Y bar (Ten)	40.5 in	X-bar	19.5 in
Moment of Inertia:	I _{xx}	224400 in ⁴	I _{yy}	36720 in ⁴	S _y	1882.83 in ³
Section Modulus:	S _x (Comp)	5541.6 in ³	S _x (Ten)	5541.6 in ³		
Radius:	r _x	33.926 in	r _y	13.722 in		
Plastic Modulus:	Z _x	6171.75 in ³	Z _y	2447.25 in ³		
Torsional Constant:	J	92.61 in ⁴				

Based on AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition, 2007, With 2008 & 2009 Interim Revisions
 Article 6.10 - I-Section Flexural Members
 Article 6.10.6 - Strength Limit State
 Article 6.10.6.2 - Flexure
 Article 6.10.6.2.3 - Composite Sections in Negative Flexure and Noncomposite Sections

If the following conditions are met, proportion the section according to the provisions for compact or noncompact web sections specified in Appendix A. Otherwise, the section shall be proportioned according to provisions specified in Article 6.10.8.

Depth of Web in Comp:	D _c :	39 in
Moment of Inertia Comp Flange:	I _{yc} :	7414.9 in ⁴
Moment of Inertia Tens Flange:	I _{yt} :	7414.9 in ⁴

Yield Strength Limit:	Max F _y :	36 ksi	Limit F _y :	70 ksi	OK - Keep Going
Web Slenderness Limit (slender):	2*D _c /tw:	156	5.7*(E/F _{yc}) ^{0.5} :	161.8 ksi	OK - Keep Going
Flange Ratio:	I _{yc} /I _{yt} :	1	Limit:	0.3	OK - Keep Going

Appendix A6: Flexural Resistance of Straight Composite I-Sections in Negative Flexure and Straight Non-composite I-sections with Compact or Noncompact Webs
 Article A6.1 - General - Same as Article 6.10.6.2.3 above.
 Article A6.1.1 - Sections with Discretely Braced Compression Flanges

At the limit state the following requirement shall be satisfied: $M_u + (1/3) * f_l * S_{xc} \leq \phi(f) * M_{nc}$

Bending Moment - Major Axis:	M _u :	Varies, see Risa 3D
Flange Lateral Bending Stress:	f _l :	See Article 6.10.1.6

Flange lateral bending stress, f_l, may be determined directly from first-order elastic analysis in discretely braced compression flanges for which: $\lambda \leq 1.2 * L_p * (C_b * R_b / (M_u / M_{yc}))^{0.5}$

Limiting Unbraced Length:	L _p :	See Article 6.10.8.2.3
	L _p :	1.0 * r _t * (E/F _{yc}) ^{0.5}
Effective Radius of Gyration:	r _t :	b _{tc} / (12 * (1 + (1/3) * (D _c * tw / (b _{tc} * t _{fc})))) ^{0.5}
	r _t :	10.7 in
	L _p :	303.1 in

Moment Gradient Modifier:	C _b :	See Article 6.10.8.2.3 or Article A6.3.3, as applicable
	C _b :	1 Since M _{mid} /M ₂ > 1 at most situations. May be conservative at some locations.

Web Load-shedding Factor:	R _b :	See Article 6.10.1.10.2	1.0 if 2*D _c /tw ≤ λ _{md} (rw)
Web Slenderness Limit (noncompact):	λ _{md} (rw):	5.7*(E/F _{yc}) ^{0.5}	161.8
	2*D _c /tw:	156	
	R _b :	1	

Major Axis Bending to Yield Moment:	M _u /M _{yc} :	1 Assume 1.0. Conservative.
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Unbraced Limit for f _l :	L _b :	301.2 in	1.2 * L _p * (C _b * R _b / (M _u / M _{yc})) ^{0.5}	363.8 in	OK - Keep Going, First-order elastic analysis
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Flange Lateral Bending Stress:	f _l :	M _{uy} /S _y	First-order elastic analysis
Factored Weak Axis Bending Moment:	M _{uy} :	See Risa	

Resistance Factor for Flexure:	φ(f):	1 As specified in Article 6.5.4.2
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Nominal Flexural Resistance: M_{nc}: See Article A6.3
 Nominal Flexural Resistance based on compression flange, M_{nc}, shall be taken as the smaller of the local buckling resistance determined as specified in Article A6.3.2, and the lateral torsional buckling resistance determined as specified in Article A6.3.3.

Article A6.3.2 - Local Buckling Resistance:
 Determine if the compression flange is compact:

5/5/10
 BB-9

Limiting Slenderness Ratio for Compact Flange: Use two ratios, one for the flange between the webs, and the other for the flange overhang. See AISC Table B4.1.

Case 12: Uniform compression in flanges of rectangular box and hollow structural sections of uniform thickness subject to bending or compression.

λ_{mf}	b/t_f	22.00 <i>Clear space between webs/t_f</i>
λ_{mpf}	$1.12 \sqrt{E/F_y}$	31.79
λ_{mr}	$1.40 \sqrt{E/F_y}$	39.74

Case 12: Compact Flange

Case 2: Flexure in flanges of doubly and singly symmetric I-shaped built-up sections.

λ_{mf}	b/t_f	1.83 <i>Flange overhang measured from mid-web/t_f</i>
λ_{mpf}	$0.38 \sqrt{E/F_y}$	10.79
λ_{mr}	$0.95 \sqrt{E/k_c/F_y}$	19.07

k_c : $4/(D/t_w)^{0.5}$: 0.32 but $0.35 \leq k_c \leq 0.76$

k_c	0.35
F_{yr}	smaller of 3 items below:
	$0.7 F_{yc}$: 25.2 ksi
	$R_h F_{yt} S_{xt}/S_{xc}$: 36.0 ksi
	F_{yw} : 36.0 ksi
	but not less than:
	$0.5 F_{yc}$: 18.0 ksi

F_{yr} : 25.2 ksi

Case 2: Compact Flange *If Case 2 Flange is Noncompact or Slender, then check λ mdas used.*

Compression Flange: Compact Flange *Worse condition of Case 12 and Case 2*

Nominal Flexural Resistance: $M_{nc} = M_{pc} = R_{pc} M_{yc}$ *Equation A6.3.2-1 or A6.3.2-2*

Web Plastification Factor - Comp: R_{pc} : See Article A6.2.1 or A6.2.2, as applicable

Article A6.2.1 - Compact Web Sections:

Determine if the web is compact:

Compact if $2 D_{cp}/t_w \leq \lambda_{mf}$ ($p_w(D_{cp})$)

Depth of Web in Comp at Plastic Mom: D_{cp} : See Article D6.3.2

For non composite sections where: $F_{yw} A_w \geq [F_{yc} A_c - F_{yt} A_t]$, $D_{cp} = D/(2 A_w F_{yw}) [F_{yt} A_t + F_{yw} A_w - F_{yc} A_c]$, otherwise $D_{cp} = D$.

$F_{yw} A_w$: 2808 kip $|F_{yc} A_c - F_{yt} A_t|$: 0 kip *Use $2 D^* t_w$ for A_w due to two webs*

D_{cp} : 39.0 in

Limiting Slenderness Ratio for Compact Web:

λ_{mf} ($p_w(D_{cp})$): $((E/F_y)^{0.5})/(0.54 (M_p/(R_h M_y)) - 0.09)^{0.2} \leq \lambda_{mr} (D_{cp}/D_c)$

Plastic Moment M_p : See Article D6.1

Article D6.1 - Plastic Moment:

M_p : See Table D6.1-2, Case I

M_p : $P_w/(2 D^*) [Y(\bar{b})^2 + (D - Y(\bar{b}))^2] + [P_{rt} d_{rt} + P_{rb} d_{rb} + P_t d_t + P_c d_c]$

$Y(\bar{b})$: $(D/2) * [(P_c - P_t - P_{rt} - P_{rb})/P_w + 1]$

P_c : $F_{yc} b_c t_c$: 2106 kip

P_t : $F_{yt} b_t t_t$: 2106 kip

P_{rt} : 0 *no concrete reinforcing steel*

P_{rb} : 0 *no concrete reinforcing steel*

P_w : $F_{yw} D^* t_w^2$: 2808 kip *This is multiplied by 2 due to two webs*

$Y(\bar{b})$: 39

d_{rt} : 0 *no concrete reinforcing steel*

d_{rb} : 0 *no concrete reinforcing steel*

d_t : $Y(\bar{b}) + t_{rt}/2$: 39.75 in

d_c : $D - Y(\bar{b}) + t_{rc}/2$: 39.75 in

M_p : 222183 kip-in

Hybrid factor: R_h : See Article 6.10.1.10.1

R_h : 1

Yield Moment M_y : Smaller of M_{yc} and M_{yt} , See Article D6.2.

M_{yc} : $F_{yc} S_{xc}$: 199498 kip-in

M_{yt} : $F_{yt} S_{xt}$: 199498 kip-in

M_y : 199497.6 kip-in

λ_{mf} ($p_w(D_{cp})$): smaller of

$((E/F_y)^{0.5})/(0.54 (M_p/(R_h M_y)) - 0.09)^{0.2}$: 108.5

$\lambda_{mr} (D_{cp}/D_c)$: 161.8

λ_{mf} ($p_w(D_{cp})$): 108.5

Web Compact? $2 D_{cp}/t_w$: 156.0

λ_{mf} ($p_w(D_{cp})$): 108.5

Web is not compact, See Article A6.2.2

Web Plastification Factor - Comp: R_{pc} : M_p/M_{yc} : 1.114 *See A6.2.2, as applicable*

Article A6.2.2 - Noncompact Web Sections Verify the webs are non-compact and not slender.

If $\lambda_{mf}(w) < \lambda_{mr}(w)$, then noncompact.

Slenderness ratio for web: $\lambda_{mf}(w)$: $2 D_{cp}/t_w$: 156

Limiting Slenderness ratio for noncompact web:

$\lambda_{mr}(w)$: $5.7 \sqrt{E/F_y}$: 161.8

Noncompact vs Slender webs? Noncompact, keep going

Web Plastification Factor - Comp: R_{pc} : smaller of $[1 - (1 - (R_h M_{yc}/M_p)) * ((\lambda_{mf}(w) - \lambda_{mf}(D_{cp})) / (\lambda_{mr}(w) - \lambda_{mf}(D_{cp})))] * (M_p/M_{yc})$

Limiting Slenderness ratio for a compact web:

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$\lambda(pw(Dc))$: smaller of $\lambda(pw(Dcp)) * (Dc/Dcp)$
 $\lambda(pw(Dcp)) * (Dc/Dcp)$ 108.5
 $\lambda(pw(Dc))$: 108.5

$[1 - (1 - (R_h * Myc / Mp)) * ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] * (Mp / Myc)$ 1.012
 Mp / Myc 1.114

R_{pc} : 1.012 *Use if Web is Noncompact*

Web Plastification Factor - Comp: R_{pc} (FINAL): 1.012

Nominal Flexural Resistance - comp: M_{nc} : 201959 kip-in Per Article A6.3.2

Article A6.3.3 - Lateral Torsional Buckling Resistance:

If $L_b \leq L_p$, then $M_{nc} = R_{pc} * Myc$
 $L_b \leq L_p$, therefore $M_{nc} = R_{pc} * Myc$ (Same as A6.3.2)
 M_{nc} : 201959 kip-in Per Article A6.3.3

Nominal Flexural Resistance - Comp: M_{nc} : 201959 kip-in

A6.4 - Flexural Resistance Based on Tension Flange Yielding

Nominal Flexural Resistance - tension: M_{nt} : $R_{pt} * Myt$
 Web Plastification Factor - Ten: R_{pt} : See Article A6.2.1 or Article A6.2.2 as applicable.

Article A6.2.1 - Compact Web Sections
 R_{pt} : Mp / Myt

1.114 *Use if Web is Compact*

Article A6.2.2 - Noncompact Web Sections

R_{pt} : smaller of $[1 - (1 - (R_h * Myt / Mp)) * ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] * (Mp / Myt)$
 Mp / Myt

$[1 - (1 - (R_h * Myt / Mp)) * ((\lambda(w) - \lambda(pw(Dc))) / (\lambda(rw) - \lambda(pw(Dc))))] * (Mp / Myt)$ 1.012
 Mp / Myt 1.114

R_{pt} : 1.012 *Use if Web is Noncompact*

R_{pt} (FINAL): 1.012

Nominal Flexural Resistance - Ten: M_{nt} : 201959 kip-in

5
 BB-11



PROJECT MnDOT SS -69801 N - P6-3A - Shear Resistance -1

PROJECT # 090147 DATE 1/28/2010 BY jdf SHEET NO. _____ OF _____

$\sqrt{csm}$
5110/10

Determine V_n using Article 6.10.9

Southern End panel will control as it has the largest stiffener spacing and highest Reactions. ✓

End panel: 6.10.9.3.3

$$V_n = V_{cr} = C V_p$$

$C \Rightarrow$ See 6.10.9.3.2-4, -5 or -6 based on $\frac{D}{t_w}$

$$D = 78" \checkmark$$

$$t_w = 1/2" \checkmark$$

$$D/t_w = 156 \checkmark$$

If $\frac{D}{t_w} \leq 1.12 \sqrt{\frac{E_k}{F_{yw}}}$ then use 6.10.9.3.2-4

$$K = 5 + \frac{5}{\left(\frac{d_o}{D}\right)^2}$$

$$d_o = \text{Stiffener spacing} = 4' - 6 \frac{5}{16}" = 54.3" \checkmark$$

$$D = 78" \checkmark$$

$$K = 5 + \frac{5}{\left(\frac{54.3}{78}\right)^2} = 15.32 \checkmark$$

$$\frac{D}{t_w} = 156 > 1.12 \sqrt{\frac{29000 \times 15.32}{36}} = 124.4 \quad \text{"keep going"} \checkmark$$

$$\text{Is } \frac{D}{t_w} \leq 1.4 \sqrt{\frac{E_k}{F_{yw}}} = 1.40 \sqrt{\frac{29000 \times 15.32}{36}} = 155.5, \text{ NO} \checkmark$$

Since $\frac{D}{t_w} > 1.4 \sqrt{\frac{E_k}{F_{yw}}}$, use 6.10.9.3.2-6 keep going.

$$C = \frac{1.57}{\left(\frac{D}{t_w}\right)^2} \left(\frac{E_k}{F_{yw}}\right) = \frac{1.57}{(156)^2} \left(\frac{29000 \times 15.32}{36}\right) = 0.796 \checkmark$$



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PROJECT Mn DOT SS-69801N - Pb-3A - Shear Resistance -2
PROJECT # 090147 DATE 1/28/10 BY jdf SHEET NO. _____ OF _____

✓ V_{cr}
5/10/10

$$V_p = 0.58 F_y w D + w$$
$$= 0.58 \times 36 \times 78 \times \frac{1}{2} \times 2 = 1629 \text{ kip}$$

2 webs →

$$V_n = V_{cr} = 0.796 \times 1629 = 1297 \text{ kip}$$

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PROJECT MDOT SS-69801 J - Plb-3A - Transverse Stiffeners - 1

PROJECT # 090147 DATE 2/2/10 BY jdf ^{Vcm} _{5/10/10} SHEET NO. _____ OF _____

Verify the transverse stiffeners meet the requirements of Article 6.10.11.1

$$b_t \geq 2.0 + \frac{D}{30} = 2.0 + \frac{78}{30} = 4.6" \text{ min projection}$$

$$16 t_p \geq b_t \geq \frac{b_f}{4} \Rightarrow 16 \times \frac{3}{8} = 6" \geq b_t \geq \text{N.A}$$

b_t varies from 15" to 6" OK, Use 6" in calcs

$$d_o = 54.3" \checkmark$$

Determine: I_{t1} , I_{t2} , I_{t3} , V_u , & V_{cr}

$$I_{t1} = \frac{b d^3}{3} = \frac{37.5 \times 6^3}{3} = 27 \text{ in}^4 \quad \uparrow \text{ per 6.10.9.2}$$

$$I_{t1} = b t_w^3 J$$

$$b = \text{smaller of } d_o \text{ or } D = 54.3"$$

$$t_w = \frac{1}{2}"$$

$$J = \frac{2.5}{(d_o/D)^2} - 2.0 \geq 0.5 \checkmark$$

$$= \frac{2.5}{(54.3/78)^2} - 2.0 = 3.16 \geq 0.5 \checkmark$$

$$I_{t1} = 54.3 \times \left(\frac{1}{2}\right)^3 \times 3.16 = 21.4 \text{ in}^4$$

$$I_{t2} = \frac{D^4 P_{\epsilon}^{1.3}}{40} \left(\frac{F_{yw}}{E}\right)^{1.5}$$

$$D = 78" \checkmark$$

$$P_{\epsilon} = F_{yw}/F_{crs} \text{ or } 1.0 \text{ (larger of the two)}$$

$$F_{yw} = 36 \text{ ksi} \checkmark$$

$$F_{crs} = \frac{0.31 E}{(b/t_p)^2} \leq F_{ys} \quad \begin{matrix} 36 \text{ ksi} \\ 6" \end{matrix}$$

$$= \frac{0.31 \times 29000}{(6/3.75)^2} = 35.12 < 36 \text{ ksi}$$

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PROJECT MnDOT SS-69801 J-P6-3A - Transverse Stiffeners - 2

PROJECT # 090147 DATE 2/10/10 BY jdj ^{1/5m} _{5/10/10} SHEET NO. _____ OF _____

$$P_t = \frac{F_{yw}}{F_{crs}} = \frac{36}{35.12} = 1.025 > 1.0$$

$$I_{t2} = \frac{78^4 \times (1.025)^{1.3}}{40} \left(\frac{36}{29000} \right)^{1.5} = 41.79 \text{ in}^4$$

$$V_u = 1.25 \times 374.85 + 1.75 \times 259.0 = 921.8 \text{ k}$$

$\sqrt{DL}$ $\sqrt{LL+IM}$

371.98 259.5

$$\phi_v = 1.0$$

$$V_{cr} = \text{per 6.10.9.2}$$

$$V_n = V_{cr} = C V_p$$

$$C = \Rightarrow (w/k = 5.0) \text{ see 6.10.9.3.2-4 thru -6}$$

$$\frac{D}{t_w} = 78/1.5 = 156$$

$$1.12 \sqrt{\frac{E K}{F_{yw}}} = 1.12 \sqrt{\frac{29000 \times 5}{36}} = 71.08$$

$$1.40 \sqrt{\frac{E K}{F_{yw}}} = 1.40 / 1.12 \times 71.08 = 88.85$$

$$\text{Since } \frac{D}{t_w} > 1.40 \sqrt{\frac{E K}{F_{yw}}} \text{ use 6.10.9.3.2-6}$$

$$C = \frac{1.57}{(D/t_w)^2} \left(\frac{E K}{F_{yw}} \right) = \frac{1.57}{156^2} \left(\frac{29000 \times 5}{36} \right) = 0.2598$$

$$V_p = 0.58 \times F_{yw} \times D \times t_w$$

$$= 0.58 \times 36 \times 78 \times 1.5 \times 2 = 1628.64 \text{ k}$$

$$V_{cr} = C V_p = 0.2598 \times 1628.64 = 423.1 \text{ k}$$

$$V_u > \phi V_{cr} \therefore \text{Use 6.10.11.1.3-7 or -8}$$

$$I_{t2} > I_{t1} \therefore \text{Use 6.10.11.1.3-7}$$



PROJECT MnDOT SS-698011-P6-3A - Transverse Stiffness - 3

PROJECT # 090147 DATE 2/10/10 BY Jdf SHEET NO. 1 OF 5

$$I_t \geq I_{t1} + (I_{t2} - I_{t1}) \left(\frac{V_u - \phi_v V_{cr}}{\phi_v V_n - \phi_v V_{cr}} \right)$$

$V_n \Rightarrow$ smaller of the (nominal combined buckling and tension shear resistances) of the adjacent web panels, determined as specified in Article 6.10.9.3.2.

$$I_s = \frac{2Dt_w}{(b_{ft}t_{ft} + b_{fb}t_{fb})} \leq 2.5?$$

↙ 2 webs

$$\frac{2 \times 78 \times 5 \times 2}{2 \times 39 \times 1/2} = 1.33 \leq 2.5, \text{ Use 6.10.9.3.2-2.}$$

$$V_n = V_p \left[C + \frac{0.87(1-C)}{\sqrt{1 + \left(\frac{d_o}{D}\right)^2}} \right]$$

$$V_p = 1628.64 \text{ k}$$

$$C \Rightarrow \frac{D}{t_w} = \frac{78}{.5} = 156$$

$$K = 5 + \frac{5}{\left(\frac{d_o}{D}\right)^2} = 5 + \frac{5}{\left(\frac{54.3}{78}\right)^2} = 15.32$$

$$1.12 \sqrt{\frac{E K}{F_{yw}}} = 1.12 \sqrt{\frac{29000 \times 15.32}{36}} = 124.4$$

$$1.40 \sqrt{\frac{E K}{F_{yw}}} = 124.4 \times \frac{1.40}{1.12} = 155.5$$

Since $\frac{D}{t_w} > 1.40 \sqrt{\frac{E K}{F_{yw}}}$, Use 6.10.9.3.2-6

$$C = \frac{1.57}{\left(\frac{D}{t_w}\right)^2} \left(\frac{E K}{F_{yw}} \right) = \frac{1.57}{156^2} \left(\frac{29000 \times 15.32}{36} \right) = 0.796$$

$$V_n = 1628.64 \left[0.796 + \frac{0.87(1-0.796)}{\sqrt{1 + \left(\frac{54.3}{78}\right)^2}} \right] = 1628.64 \times .9417 = 1533.6 \text{ kips}$$

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PROJECT MnDOT SS-69801J-Pb.3A - Transverse Stiffeners - 4

PROJECT # 090147 DATE 2/10/10 BY jdj [✓] _{5/10/10} SHEET NO. _____ OF _____

$$I_t \geq 21.4 + (41.79 - 21.4) \left(\frac{921.8 - 1.0 \times 423.1}{1.0 \times 1533.6 - 1.0 \times 423.1} \right)$$

$$I_t \geq 21.4 + (20.39) (0.44908)$$
$$I_t \geq 30.56 \text{ in}^4$$

our $I_t = 27 \text{ in}^4$ $\therefore$ No Good ✓

Stiffeners are not OK ✓

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PROJECT Mn DOT SS - 69801 J - P6-3A - Stiffener Type C -1
PROJECT # 090147 DATE 6/21/10 BY jdF SHEET NO. 1 OF 1
6/25/10

Check Stiffener C Capacity wrt Article 6-10-11.1

$$b_t \geq 2.0 + \frac{D}{30} = 2.0 + \frac{40}{30} = 3.33" \text{ min projection}$$

$$D_{max} = 3'-4" = 40"$$

$$16 t_p \geq b_t \geq \frac{b_r}{4} \Rightarrow 16 \times \frac{3}{8} = 6" \geq b_t \geq N.A.$$

$$b_t = 6" \text{ OK}$$

Check Stiffener @ Girder E

$$d_o = 36.125" \text{ OK}$$

Determine: I_t , I_{t1} , I_{t2} , V_u & ϕV_c

$$I_t = \frac{b d^3}{3} = \frac{37.5 \times 6^3}{3} = 27 \text{ in}^4$$

$$I_{t1} = b t_w^3 J$$

$$b = \text{smaller of } d_o \text{ or } D = 36.125"$$

$$t_w = \frac{1}{2}"$$

$$J = \frac{2.5}{(d_o/D)^2} - 2.0 \geq 0.5$$

$$= \frac{2.5}{(36.125/40)^2} - 2.0 = 1.065 > 0.5$$

$$I_{t1} = 36.125 \times .5^3 \times 1.065 = 4.809 \text{ in}^4$$

$$I_{t2} = \frac{D^4 \rho_t^{1.3}}{40} \left(\frac{F_{yw}}{E} \right)^{1.5}$$

$$D = 40"$$

$$\rho_t = \frac{F_{yw}}{F_{crs}} \text{ or } 1.0 \text{ (larger of the two)}$$

$$F_{yw} = 36 \text{ ksi}$$

$$F_{crs} = \frac{0.81 E}{(b/t_p)^2} \leq F_{ys} \leftarrow 36 \text{ ksi}$$

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PROJECT MDOT SS-69801 J - P6-3A - Stiffener Type C -2

PROJECT # 090147 DATE 6/21/10 BY jad SHEET NO. 1 OF 1

$$F_{crs} = \frac{0.31 \times 29000}{(6/1.375)^2} = 35.12 < 36 \text{ ksi}$$

$$p_c = 36 / 35.12 = 1.025 > 1.0$$

↑ use this.

$$I_{t2} = \frac{40^4 \times 1.025^{1.3}}{40} \left(\frac{36}{29000} \right)^{1.5} = 2.891 \text{ in}^4$$

$$V_u = 1.25 \times 371.975 + 1.75 \times 259.543 = 919.2 \text{ kip}$$

$$\phi_v = 1.0$$

$V_{cr} \Rightarrow$ per Article 6.10.9.2

$$V_{cr} = C V_p$$

$$C \Rightarrow w/k = 5.0, \text{ see 6.10.9.3.2-4 thru -6}$$

$$\frac{D}{t_w} = \frac{78}{1/2} = 156 \quad \checkmark \quad (\text{use full } D)$$

$$1.12 \sqrt{E K / F_{yw}} = 71.08 \quad \checkmark$$

$$1.40 \sqrt{E K / F_{yw}} = 88.85 \quad \checkmark$$

Since $\frac{D}{t_w} > 1.40 \sqrt{E K / F_{yw}}$, use 6.10.9.3.2-6

$$C = \frac{1.57}{\left(\frac{D}{t_w} \right)^2} \left(\frac{E K}{F_{yw}} \right) = \frac{1.57}{156^2} \left(\frac{29000 \times 5}{36} \right) = 0.2598$$

$$V_p = 0.58 \times F_{yw} \times D \times t_w$$

$$= 0.58 \times 36 \times 78 \times 1/2 = 1628.64 \text{ kip}$$

↑ use full D here

$$V_{cr} = 0.2598 \times 1628.64 = 423.1 \text{ kip}$$

$$V_u > V_{cr} \therefore \text{Use 6.10.11.1.3-7 or -8}$$

$$I_{t1} > I_{t2} \therefore \text{Use 6.10.11.1.3-8}$$

$$I_{t1} \geq I_{t2} \rightarrow 27 > 2.891 \text{ in}^4$$

OK

BB-19

316013-3A-96
HL-99RATING



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PROJECT MnDOT 55-69801J-3A-P6-RF Moment, $\phi_s = 0.85$ -1
PROJECT # 090147 DATE 1/27/10 BY jdP SHEET NO. _____ OF _____

Determine the moment Rating Factor

Using Article 6.10, $R_n = M_{nc} = 201892 \text{ kip}\cdot\text{in}$
 $= 16824 \text{ kip}\cdot\text{ft}$

$$\begin{aligned} M_{DL} &= 6233.3 \text{ kip}\cdot\text{ft} \\ M_{LL+I \times} &= 4641.8 \text{ kip}\cdot\text{ft} \\ M_{LL+I \times y} &= 127.1 \text{ kip}\cdot\text{ft} \\ S_x &= 5541.61 \text{ in}^3 \\ S_y &= 1882.83 \text{ in}^3 \end{aligned} \quad \left. \begin{array}{l} \text{From Rise} \\ \text{From Rise} \end{array} \right\} \begin{aligned} &= 74800 \text{ kip}\cdot\text{in} \\ &= 5542 \text{ kip}\cdot\text{in} \\ &= 1321 \text{ kip}\cdot\text{in} \end{aligned}$$

Rating Equation $\Rightarrow$

$$RF = \frac{C - \gamma_{DL} \times DL}{\gamma_{LL} (LL + Im)}$$

$$C = \phi_c \phi_s \phi R_n = 1.0 \times 0.85 \times 1.0 \times 201892 = 171608 \text{ kip}\cdot\text{in}$$

$$\gamma_{DL} = 1.25$$

$$DL = 74800 \text{ kip}\cdot\text{in}$$

$$\gamma_{LL} = 1.35 \text{ for operating}$$

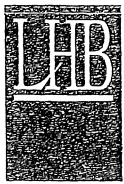
$$= 1.75 \text{ for inventory}$$

$$\begin{aligned} LL + Im &= M_x + \frac{1}{3} \frac{M_y}{S_y} \times S_x \\ &= 5542 + \frac{1}{3} \times \left(\frac{1321}{1882.83} \right) \times 5541.61 \\ &= 56997 \text{ kip}\cdot\text{in} \end{aligned}$$

$$RF_{oper} = \frac{171608 - 1.25 \times 74800}{1.35 \times 56997} = 1.03$$

$$RF_{inv} = \frac{171608 - 1.25 \times 74800}{1.75 \times 56997} = 0.78$$

★
rr-1



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PROJECT MnDOT SS-69801J-3A-P6 - RF Moment, $\phi_s = 0.95$ -1
PROJECT # 090147 DATE 1/27/10 BY jdf SHEET NO. _____ OF _____

Determine the moment Rating Factor

Using Article 6.10, $R_n = M_n = 201892 \text{ kip}\cdot\text{in}$
 $= 16824 \text{ kip}\cdot\text{ft}$

$$\begin{aligned} M_{DL} &= 6233.3 \text{ kip}\cdot\text{ft} \\ M_{LL+I} &= 4647.8 \text{ kip}\cdot\text{ft} \\ M_{LL+I} &= 110.1 \text{ kip}\cdot\text{ft} \\ S_x &= 5541.61 \text{ in}^3 \\ S_y &= 1882.83 \text{ in}^3 \end{aligned} \quad \left. \begin{array}{l} \\ \\ \\ \end{array} \right\} \text{From Rise} \quad \begin{aligned} &= 73784 \text{ kip}\cdot\text{in} \\ &= 55701 \text{ kip}\cdot\text{in} \\ &= 1321.152 \text{ kip}\cdot\text{in} \end{aligned}$$

Rating Equation $\Rightarrow$

$$RF = \frac{C - \gamma_{DL} \times DL}{\gamma_{LL} (LL + Im)}$$

$$C = \phi_c \phi_s \phi R_n = 1.0 \times 0.95 \times 1.0 \times 201892 = 191797 \text{ kip}\cdot\text{in}$$

$$\gamma_{DL} = 1.25$$

$$DL = 74800 \text{ kip}\cdot\text{in}$$

$$\gamma_{LL} = 1.35 \text{ for operating}$$

$$= 1.75 \text{ for inventory}$$

$$\begin{aligned} LL + Im &= M_x + \frac{1}{3} \frac{M_y}{S_y} \times S_x \\ &= 55701 + \frac{1}{3} \times \left(\frac{1321.152}{1882.83} \right) \times 5541.61 \\ &= 56997 \text{ kip}\cdot\text{in} \end{aligned}$$

$$RF_{oper} = \frac{191797 - 1.25 \times 74800}{1.35 \times 56997} = 1.02$$

$$RF_{inv} = \frac{191797 - 1.25 \times 74800}{1.75 \times 56997} = 0.99$$



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PROJECT MnDOT SS-69801 J-3A-P6 - RF Shear

-1

PROJECT # 090147

DATE 2/2/10

BY jdf
VCTM

SHEET NO. _____ OF _____

Determine Shear Rating Factor

Evaluate at South Bearing

$$R_n = 1297 \text{ kip} \checkmark$$

$$V_{DL} = \cancel{374.9} \text{ k} / 372.0 \checkmark$$

$$V_{LL+Im} = \cancel{259.0} \text{ k} \quad 259.5 \checkmark$$

$$RF_{oper} = \frac{1.0^3 \times 1297 - 1.25 \times \cancel{374.9} \quad 372.0}{1.35 \times \cancel{259.0} \quad 259.5} = \cancel{2.37} \quad 2.37 \checkmark$$

$$RF_{inv} = \frac{1.0^3 \times 1297 - 1.25 \times \cancel{374.9} \quad 372.0}{1.75 \times \cancel{259.0} \quad 259.5} = \cancel{1.83} \quad 1.83 \checkmark$$

★ CC-3

68013-7A-P6
Postings + Permit

MnDOT Special Structures, 69801N

Pier Cap P6-3A Reactions under posting and permit loads

22-Mar-10

<u>Risa</u>		<u>Total Truck</u>	<u>Reaction at</u>	<u>Wheel Load</u>
<u>Girder</u>				
<u>LC</u>	<u>Truck:</u>	<u>Weight (kip)</u>	<u>P2-3E (kip)</u>	<u>(kip)</u>
15	POST-TYPE3UNIT	48	47.544	23.77
16	POST-TYPE3S2-40UNIT	80	73.485	36.74
17	POST-TYPE3S3UNIT	80	74.51	37.26
18	POST-SU4-TRUCK	54	53.463	26.73
19	POST-SU5-TRUCK	62	61.149	30.57
20	POST-SU6-TRUCK	69.5	68.452	34.23
21	POST-SU7-TRUCK	77.5	76.111	38.06
22	PERMIT-STD-A-TRUCK	104	98.703	49.35
23	PERMIT-STD-B-TRUCK	136	126.366	63.18
24	PERMIT-STD-C-TRUCK	159	144.944	72.47
25	PERMIT-P411-TRUCK	207	159.648	79.82
26	PERMIT-P413-TRUCK	255	177.033	88.52
27	PERMIT-STD-C152B	152.2	139.922	69.96
28	PERMIT-STD-C174B	174	154.824	77.41
29	PERMIT-STD-C198_23	198	165.566	82.78
30	PERMIT-STD-C214B	214	172.784	86.39
31	PERMIT-STD-C237B	237.4	174.594	87.30
32	PERMIT-STD-C256B	256	176.736	88.37
33	PERMIT-STD-C200J	200	172.317	86.16

DD-1

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Mar 22, 2010
 9:48 AM
 Checked By: CJM

Post- Type 3 Unit

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	15	1.163	15	0	15	0	15	0	15	0	15
2		min	0	15	-.191	15	0	15	0	15	0	15	0	15
3	P3-3C	max	0	15	.963	15	0	15	0	15	0	15	0	15
4		min	0	15	-5.875	15	0	15	0	15	0	15	0	15
5	P2-3C	max	0	15	47.377	15	0	15	0	15	0	15	0	15
6		min	0	15	-3.779	15	0	15	0	15	0	15	0	15
7	P1-3C	max	0	15	47.938	15	0	15	0	15	0	15	0	15
8		min	0	15	-.608	15	0	15	0	15	0	15	0	15
9	P7-3A	max	0	15	49.563	15	0	15	0	15	0	15	0	15
10		min	0	15	-5.987	15	0	15	0	15	0	15	0	15
11	P6-3A-FTG	max	0	15	47.544	15	0	15	0	15	0	15	0	15
12		min	0	15	-5.892	15	0	15	0	15	0	15	0	15
13	P5-3A-FTG	max	0	15	49.417	15	0	15	0	15	0	15	0	15
14		min	0	15	-4.22	15	0	15	0	15	0	15	0	15
15	P4-3A-FTG	max	0	15	0	15	0	15	0	15	0	15	0	15
16		min	0	15	0	15	0	15	0	15	0	15	0	15
17	P4-3A	max	0	15	47.273	15	0	15	0	15	0	15	116.577	15
18		min	0	15	-4.852	15	0	15	0	15	0	15	-118.34	15
19	P3-3A-FTG	max	0	15	46.929	15	0	15	0	15	0	15	0	15
20		min	0	15	-4.569	15	0	15	0	15	0	15	0	15
21	P2-3A	max	0	15	46.966	15	0	15	0	15	0	15	0	15
22		min	0	15	-4.49	15	0	15	0	15	0	15	0	15
23	P1-3A	max	0	15	41.468	15	0	15	0	15	0	15	0	15
24		min	0	15	-3.868	15	0	15	0	15	0	15	0	15
25	H5	max	0	15	0	15	0	15	0	15	0	15	0	15
26		min	0	15	0	15	0	15	0	15	0	15	0	15
27	Totals:	max	0	15	48	15	0	15						
28		min	0	15	14	15	0	15						

47.026
 +.5 46.963
 - 1 47.091
 - 1 47.192
 -.5 47.229
 - 1 47.272

- 49.09
 + 5 - 67.58
 + 5' - 84.21
 + 5' - 98.29
 + 5' - 109.133
 + 5' - 116.05
 + 2' - 117.564
 + 2' - 118.296
 + 1' - 118.335

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Mar 22, 2010
 9:49 AM
 Checked By: CJW

Post-Type 352-40 Unit

5/16/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	16	1.642	16	0	16	0	16	0	16	0	16
2		min	0	16	-227	16	0	16	0	16	0	16	0	16
3	P3-3C	max	0	16	1.148	16	0	16	0	16	0	16	0	16
4		min	0	16	-8.297	16	0	16	0	16	0	16	0	16
5	P2-3C	max	0	16	66.247	16	0	16	0	16	0	16	0	16
6		min	0	16	-4.504	16	0	16	0	16	0	16	0	16
7	P1-3C	max	0	16	73.008	16	0	16	0	16	0	16	0	16
8		min	0	16	-8	16	0	16	0	16	0	16	0	16
9	P7-3A	max	0	16	68.672	16	0	16	0	16	0	16	0	16
10		min	0	16	-8.496	16	0	16	0	16	0	16	0	16
11	P6-3A-FTG	max	0	16	73.485	16	0	16	0	16	0	16	0	16
12		min	0	16	-6.737	16	0	16	0	16	0	16	0	16
13	P5-3A-FTG	max	0	16	68.618	16	0	16	0	16	0	16	0	16
14		min	0	16	-5.675	16	0	16	0	16	0	16	0	16
15	P4-3A-FTG	max	0	16	0	16	0	16	0	16	0	16	0	16
16		min	0	16	0	16	0	16	0	16	0	16	0	16
17	P4-3A	max	0	16	69.298 ^①	16	0	16	0	16	0	16	130.232	16
18		min	0	16	-5.547	16	0	16	0	16	0	16	-143.514 ^②	16
19	P3-3A-FTG	max	0	16	66.472	16	0	16	0	16	0	16	0	16
20		min	0	16	-5.052	16	0	16	0	16	0	16	0	16
21	P2-3A	max	0	16	66.33	16	0	16	0	16	0	16	0	16
22		min	0	16	-5.029	16	0	16	0	16	0	16	0	16
23	P1-3A	max	0	16	42.13	16	0	16	0	16	0	16	0	16
24		min	0	16	-4.441	16	0	16	0	16	0	16	0	16
25	H5	max	0	16	0	16	0	16	0	16	0	16	0	16
26		min	0	16	0	16	0	16	0	16	0	16	0	16
27	Totals:	max	0	16	80	16	0	16						
28		min	0	16	12	16	0	16						

67.48
 +1' 67.84
 +1' 68.16
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 +1' 68.67
 +1' 68.87
 +2' 69.162
 +1' 69.25
 +1' 69.294
 +1' 69.297

-136.72
 +2 -140.259
 +.99 -141.626
 +1.01 -142.685
 +1 -143.325
 +1 -143.541

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Mar 22, 2010
 9:49 AM
 Checked By: *CSM*

Post-Type 353 Unit

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	17	1.699	17	0	17	0	17	0	17	0	17
2		min	0	17	-245	17	0	17	0	17	0	17	0	17
3	P3-3C	max	0	17	1.236	17	0	17	0	17	0	17	0	17
4		min	0	17	-8.585	17	0	17	0	17	0	17	0	17
5	P2-3C	max	0	17	68.144	17	0	17	0	17	0	17	0	17
6		min	0	17	-4.847	17	0	17	0	17	0	17	0	17
7	P1-3C	max	0	17	74.064	17	0	17	0	17	0	17	0	17
8		min	0	17	-8.37	17	0	17	0	17	0	17	0	17
9	P7-3A	max	0	17	69.177	17	0	17	0	17	0	17	0	17
10		min	0	17	-8.781	17	0	17	0	17	0	17	0	17
11	P6-3A-FTG	max	0	17	74.51	17	0	17	0	17	0	17	0	17
12		min	0	17	-7.024	17	0	17	0	17	0	17	0	17
13	P5-3A-FTG	max	0	17	69.225	17	0	17	0	17	0	17	0	17
14		min	0	17	-5.939	17	0	17	0	17	0	17	0	17
15	P4-3A-FTG	max	0	17	0	17	0	17	0	17	0	17	0	17
16		min	0	17	0	17	0	17	0	17	0	17	0	17
17	P4-3A	max	0	17	70.828 ⁽³⁾	17	0	17	0	17	0	17	141.822	17
18		min	0	17	-6.008	17	0	17	0	17	0	17	-153.541 ⁽⁴⁾	17
19	P3-3A-FTG	max	0	17	68.051	17	0	17	0	17	0	17	0	17
20		min	0	17	-5.405	17	0	17	0	17	0	17	0	17
21	P2-3A	max	0	17	67.972	17	0	17	0	17	0	17	0	17
22		min	0	17	-5.46	17	0	17	0	17	0	17	0	17
23	P1-3A	max	0	17	44.334	17	0	17	0	17	0	17	0	17
24		min	0	17	-4.803	17	0	17	0	17	0	17	0	17
25	H5	max	0	17	0	17	0	17	0	17	0	17	0	17
26		min	0	17	0	17	0	17	0	17	0	17	0	17
27	Totals:	max	0	17	80	17	0	17						
28		min	0	17	9	17	0	17						

70.65
 +.5 70.709
 +.5 70.758
 +1 70.818
 +.5 70.83

-138.46
 +5 -149.57
 +1 151.02
 +1 152.196
 +1 153.035
 +.5 153.302
 +.5 153.48
 +.5 153.551

Company : LHB
Designer : jdf
Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Mar 22, 2010
9:50 AM
Checked By: *CJM*

Post - SU4 - truck

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	18	1.307	18	0	18	0	18	0	18	0	18
2		min	0	18	-.214	18	0	18	0	18	0	18	0	18
3	P3-3C	max	0	18	1.083	18	0	18	0	18	0	18	0	18
4		min	0	18	-6.606	18	0	18	0	18	0	18	0	18
5	P2-3C	max	0	18	53.219	18	0	18	0	18	0	18	0	18
6		min	0	18	-4.247	18	0	18	0	18	0	18	0	18
7	P1-3C	max	0	18	53.903	18	0	18	0	18	0	18	0	18
8		min	0	18	-.684	18	0	18	0	18	0	18	0	18
9	P7-3A	max	0	18	55.731	18	0	18	0	18	0	18	0	18
10		min	0	18	-6.731	18	0	18	0	18	0	18	0	18
11	P6-3A-FTG	max	0	18	53.463	18	0	18	0	18	0	18	0	18
12		min	0	18	-6.582	18	0	18	0	18	0	18	0	18
13	P5-3A-FTG	max	0	18	55.571	18	0	18	0	18	0	18	0	18
14		min	0	18	-4.743	18	0	18	0	18	0	18	0	18
15	P4-3A-FTG	max	0	18	0	18	0	18	0	18	0	18	0	18
16		min	0	18	0	18	0	18	0	18	0	18	0	18
17	P4-3A	max	0	18	53.15①	18	0	18	0	18	0	18	130.991	18
18		min	0	18	-5.453	18	0	18	0	18	0	18	-133.007②	18
19	P3-3A-FTG	max	0	18	52.739	18	0	18	0	18	0	18	0	18
20		min	0	18	-5.131	18	0	18	0	18	0	18	0	18
21	P2-3A	max	0	18	52.761	18	0	18	0	18	0	18	0	18
22		min	0	18	-5.047	18	0	18	0	18	0	18	0	18
23	P1-3A	max	0	18	46.217	18	0	18	0	18	0	18	0	18
24		min	0	18	-4.348	18	0	18	0	18	0	18	0	18
25	H5	max	0	18	0	18	0	18	0	18	0	18	0	18
26		min	0	18	0	18	0	18	0	18	0	18	0	18
27	Totals:	max	0	18	54	18	0	18						
28		min	0	18	12	18	0	18						

Don't need to do, SU 7 controls

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Mar 22, 2010
 9:50 AM
 Checked By: *SM*

Post SU5 - Truck

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	19	1.49	19	0	19	0	19	0	19	0	19
2		min	0	19	-243	19	0	19	0	19	0	19	0	19
3	P3-3C	max	0	19	1.226	19	0	19	0	19	0	19	0	19
4		min	0	19	-7.527	19	0	19	0	19	0	19	0	19
5	P2-3C	max	0	19	60.582	19	0	19	0	19	0	19	0	19
6		min	0	19	-4.809	19	0	19	0	19	0	19	0	19
7	P1-3C	max	0	19	61.613	19	0	19	0	19	0	19	0	19
8		min	0	19	-7.776	19	0	19	0	19	0	19	0	19
9	P7-3A	max	0	19	63.032	19	0	19	0	19	0	19	0	19
10		min	0	19	-7.671	19	0	19	0	19	0	19	0	19
11	P6-3A-FTG	max	0	19	61.149	19	0	19	0	19	0	19	0	19
12		min	0	19	-7.336	19	0	19	0	19	0	19	0	19
13	P5-3A-FTG	max	0	19	62.897	19	0	19	0	19	0	19	0	19
14		min	0	19	-5.396	19	0	19	0	19	0	19	0	19
15	P4-3A-FTG	max	0	19	0	19	0	19	0	19	0	19	0	19
16		min	0	19	0	19	0	19	0	19	0	19	0	19
17	P4-3A	max	0	19	60.604	19	0	19	0	19	0	19	147.964	19
18		min	0	19	-6.161	19	0	19	0	19	0	19	-150.584	19
19	P3-3A-FTG	max	0	19	60.004	19	0	19	0	19	0	19	0	19
20		min	0	19	-5.763	19	0	19	0	19	0	19	0	19
21	P2-3A	max	0	19	60.029	19	0	19	0	19	0	19	0	19
22		min	0	19	-5.698	19	0	19	0	19	0	19	0	19
23	P1-3A	max	0	19	51.049	19	0	19	0	19	0	19	0	19
24		min	0	19	-4.911	19	0	19	0	19	0	19	0	19
25	H5	max	0	19	0	19	0	19	0	19	0	19	0	19
26		min	0	19	0	19	0	19	0	19	0	19	0	19
27	Totals:	max	0	19	62	19	0	19						
28		min	0	19	12	19	0	19						

Don't need to do, SU7 controls

Post SUB - truck

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	20	1.665	20	0	20	0	20	0	20	0	20
2		min	0	20	-0.27	20	0	20	0	20	0	20	0	20
3	P3-3C	max	0	20	1.367	20	0	20	0	20	0	20	0	20
4		min	0	20	-8.414	20	0	20	0	20	0	20	0	20
5	P2-3C	max	0	20	67.223	20	0	20	0	20	0	20	0	20
6		min	0	20	-5.36	20	0	20	0	20	0	20	0	20
7	P1-3C	max	0	20	68.935	20	0	20	0	20	0	20	0	20
8		min	0	20	-8.67	20	0	20	0	20	0	20	0	20
9	P7-3A	max	0	20	70.274	20	0	20	0	20	0	20	0	20
10		min	0	20	-8.576	20	0	20	0	20	0	20	0	20
11	P6-3A-FTG	max	0	20	68.452	20	0	20	0	20	0	20	0	20
12		min	0	20	-7.851	20	0	20	0	20	0	20	0	20
13	P5-3A-FTG	max	0	20	70.066	20	0	20	0	20	0	20	0	20
14		min	0	20	-6.028	20	0	20	0	20	0	20	0	20
15	P4-3A-FTG	max	0	20	0	20	0	20	0	20	0	20	0	20
16		min	0	20	0	20	0	20	0	20	0	20	0	20
17	P4-3A	max	0	20	67.755	20	0	20	0	20	0	20	164.74	20
18		min	0	20	-6.865	20	0	20	0	20	0	20	-167.899	20
19	P3-3A-FTG	max	0	20	67.049	20	0	20	0	20	0	20	0	20
20		min	0	20	-6.39	20	0	20	0	20	0	20	0	20
21	P2-3A	max	0	20	67.094	20	0	20	0	20	0	20	0	20
22		min	0	20	-6.347	20	0	20	0	20	0	20	0	20
23	P1-3A	max	0	20	53.365	20	0	20	0	20	0	20	0	20
24		min	0	20	-5.471	20	0	20	0	20	0	20	0	20
25	H5	max	0	20	0	20	0	20	0	20	0	20	0	20
26		min	0	20	0	20	0	20	0	20	0	20	0	20
27	Totals:	max	0	20	69.5	20	0	20						
28		min	0	20	8	20	0	20						

Don't need to do SUB controls.

Post - SUT - truck

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	21	1.846	21	0	21	0	21	0	21	0	21
2		min	0	21	-298	21	0	21	0	21	0	21	0	21
3	P3-3C	max	0	21	1.505	21	0	21	0	21	0	21	0	21
4		min	0	21	-9.328	21	0	21	0	21	0	21	0	21
5	P2-3C	max	0	21	73.853	21	0	21	0	21	0	21	0	21
6		min	0	21	-5.903	21	0	21	0	21	0	21	0	21
7	P1-3C	max	0	21	76.564	21	0	21	0	21	0	21	0	21
8		min	0	21	-9.958	21	0	21	0	21	0	21	0	21
9	P7-3A	max	0	21	77.445	21	0	21	0	21	0	21	0	21
10		min	0	21	-9.508	21	0	21	0	21	0	21	0	21
11	P6-3A-FTG	max	0	21	76.111	21	0	21	0	21	0	21	0	21
12		min	0	21	-8.36	21	0	21	0	21	0	21	0	21
13	P5-3A-FTG	max	0	21	77.285	21	0	21	0	21	0	21	0	21
14		min	0	21	-6.669	21	0	21	0	21	0	21	0	21
15	P4-3A-FTG	max	0	21	0	21	0	21	0	21	0	21	0	21
16		min	0	21	0	21	0	21	0	21	0	21	0	21
17	P4-3A	max	0	21	75.146	21	0	21	0	21	0	21	180.81	21
18		min	0	21	-7.553	21	0	21	0	21	0	21	-185.192	21
19	P3-3A-FTG	max	0	21	74.3	21	0	21	0	21	0	21	0	21
20		min	0	21	-6.961	21	0	21	0	21	0	21	0	21
21	P2-3A	max	0	21	74.348	21	0	21	0	21	0	21	0	21
22		min	0	21	-6.969	21	0	21	0	21	0	21	0	21
23	P1-3A	max	0	21	55.309	21	0	21	0	21	0	21	0	21
24		min	0	21	-6.021	21	0	21	0	21	0	21	0	21
25	H5	max	0	21	0	21	0	21	0	21	0	21	0	21
26		min	0	21	0	21	0	21	0	21	0	21	0	21
27	Totals:	max	0	21	77.5	21	0	21						
28		min	0	21	8	21	0	21						

74.53
 -1 74.76
 -1 74.944
 -1 75.09
 -1 75.135
 -1 75.143
 -1.5 75.127
 +1 75.145

-118.7
 +10' -162.95
 +5' -177.00
 +5' -184.41
 +1' -184.97
 +1' -185.192

Permit - Std A - truck

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	22	2.3	22	0	22	0	22	0	22	0	22
2		min	0	22	-3.45	22	0	22	0	22	0	22	0	22
3	P3-3C	max	0	22	1.743	22	0	22	0	22	0	22	0	22
4		min	0	22	-11.623	22	0	22	0	22	0	22	0	22
5	P2-3C	max	0	22	91.483	22	0	22	0	22	0	22	0	22
6		min	0	22	-6.838	22	0	22	0	22	0	22	0	22
7	P1-3C	max	0	22	98.582	22	0	22	0	22	0	22	0	22
8		min	0	22	-1.154	22	0	22	0	22	0	22	0	22
9	P7-3A	max	0	22	93.738	22	0	22	0	22	0	22	0	22
10		min	0	22	-11.876	22	0	22	0	22	0	22	0	22
11	P6-3A-FTG	max	0	22	98.703	22	0	22	0	22	0	22	0	22
12		min	0	22	-9.575	22	0	22	0	22	0	22	0	22
13	P5-3A-FTG	max	0	22	93.585	22	0	22	0	22	0	22	0	22
14		min	0	22	-8.139	22	0	22	0	22	0	22	0	22
15	P4-3A-FTG	max	0	22	0	22	0	22	0	22	0	22	0	22
16		min	0	22	0	22	0	22	0	22	0	22	0	22
17	P4-3A	max	0	22	95.186	22	0	22	0	22	0	22	202.962	22
18		min	0	22	-8.566	22	0	22	0	22	0	22	-216.128	22
19	P3-3A-FTG	max	0	22	92.323	22	0	22	0	22	0	22	0	22
20		min	0	22	-7.608	22	0	22	0	22	0	22	0	22
21	P2-3A	max	0	22	92.287	22	0	22	0	22	0	22	0	22
22		min	0	22	-7.809	22	0	22	0	22	0	22	0	22
23	P1-3A	max	0	22	61.303	22	0	22	0	22	0	22	0	22
24		min	0	22	-6.846	22	0	22	0	22	0	22	0	22
25	H5	max	0	22	0	22	0	22	0	22	0	22	0	22
26		min	0	22	0	22	0	22	0	22	0	22	0	22
27	Totals:	max	0	22	104	22	0	22						
28		min	0	22	8	22	0	22						

93.525

+1 93.007
 -1 93.525
 -1 93.979
 -2 94.666
 -1 94.903
 -1 95.075
 -1 95.169
 -1 95.181
 -1 95.118

-195.293

+7 213.96
 +1 215.177
 +1 215.94
 +1 216.174

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Mar 22, 2010
 9:51 AM
 Checked By: CM

Permit - Std B - truck

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	23	2.859	23	0	23	0	23	0	23	0	23
2		min	0	23	-408	23	0	23	0	23	0	23	0	23
3	P3-3C	max	0	23	2.064	23	0	23	0	23	0	23	0	23
4		min	0	23	-14.446	23	0	23	0	23	0	23	0	23
5	P2-3C	max	0	23	113.69	23	0	23	0	23	0	23	0	23
6		min	0	23	-8.095	23	0	23	0	23	0	23	0	23
7	P1-3C	max	0	23	125.67	23	0	23	0	23	0	23	0	23
8		min	0	23	-1.413	23	0	23	0	23	0	23	0	23
9	P7-3A	max	0	23	117.858	23	0	23	0	23	0	23	0	23
10		min	0	23	-14.787	23	0	23	0	23	0	23	0	23
11	P6-3A-FTG	max	0	23	126.366	23	0	23	0	23	0	23	0	23
12		min	0	23	-11.409	23	0	23	0	23	0	23	0	23
13	P5-3A-FTG	max	0	23	117.851	23	0	23	0	23	0	23	0	23
14		min	0	23	-9.971	23	0	23	0	23	0	23	0	23
15	P4-3A-FTG	max	0	23	0	23	0	23	0	23	0	23	0	23
16		min	0	23	0	23	0	23	0	23	0	23	0	23
17	P4-3A	max	0	23	120.006	23	0	23	0	23	0	23	235.474	23
18		min	0	23	-9.945	23	0	23	0	23	0	23	-256.209	23
19	P3-3A-FTG	max	0	23	115.439	23	0	23	0	23	0	23	0	23
20		min	0	23	-9.019	23	0	23	0	23	0	23	0	23
21	P2-3A	max	0	23	115.317	23	0	23	0	23	0	23	0	23
22		min	0	23	-9.007	23	0	23	0	23	0	23	0	23
23	P1-3A	max	0	23	70.8	23	0	23	0	23	0	23	0	23
24		min	0	23	-7.966	23	0	23	0	23	0	23	0	23
25	H5	max	0	23	0	23	0	23	0	23	0	23	0	23
26		min	0	23	0	23	0	23	0	23	0	23	0	23
27	Totals:	max	0	23	136	23	0	23						
28		min	0	23	16	23	0	23						

119.79
 +1 119.57
 -1 119.79
 -1 119.934
 -1 200.006

- 233.40
 +4 - 248.63
 +1 - 251.36
 +2 - 255.126
 +1 - 256.046
 +.75 - 256.294

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Mar 22, 2010
 9:52 AM
 Checked By: Cjm

Permit - Std C - truck

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	24	3.189	24	0	24	0	24	0	24	0	24
2		min	0	24	-434	24	0	24	0	24	0	24	0	24
3	P3-3C	max	0	24	2.195	24	0	24	0	24	0	24	0	24
4		min	0	24	-16.116	24	0	24	0	24	0	24	0	24
5	P2-3C	max	0	24	126.552	24	0	24	0	24	0	24	0	24
6		min	0	24	-8.609	24	0	24	0	24	0	24	0	24
7	P1-3C	max	0	24	143.582	24	0	24	0	24	0	24	0	24
8		min	0	24	-1.551	24	0	24	0	24	0	24	0	24
9	P7-3A	max	0	24	132.636	24	0	24	0	24	0	24	0	24
10		min	0	24	-16.519	24	0	24	0	24	0	24	0	24
11	P6-3A-FTG	max	0	24	144.944	24	0	24	0	24	0	24	0	24
12		min	0	24	-12.127	24	0	24	0	24	0	24	0	24
13	P5-3A-FTG	max	0	24	132.704	24	0	24	0	24	0	24	0	24
14		min	0	24	-10.98	24	0	24	0	24	0	24	0	24
15	P4-3A-FTG	max	0	24	0	24	0	24	0	24	0	24	0	24
16		min	0	24	0	24	0	24	0	24	0	24	0	24
17	P4-3A	max	0	24	136.037	24	0	24	0	24	0	24	247.05	24
18		min	0	24	-10.475	24	0	24	0	24	0	24	-273.348	24
19	P3-3A-FTG	max	0	24	129.845	24	0	24	0	24	0	24	0	24
20		min	0	24	-9.623	24	0	24	0	24	0	24	0	24
21	P2-3A	max	0	24	129.563	24	0	24	0	24	0	24	0	24
22		min	0	24	-9.486	24	0	24	0	24	0	24	0	24
23	P1-3A	max	0	24	73.141	24	0	24	0	24	0	24	0	24
24		min	0	24	-8.404	24	0	24	0	24	0	24	0	24
25	H5	max	0	24	0	24	0	24	0	24	0	24	0	24
26		min	0	24	0	24	0	24	0	24	0	24	0	24
27	Totals:	max	0	24	159	24	0	24						
28		min	0	24	15	24	0	24						

135.77

+1 135.261

-1 135.77

-1 135.939

-1 136.031

-1.5 136.045

-270.33

+1.75 -271.76

+1.25 -272.144

+1 -273.186

+1.5 -273.385

Permit - P411 - truck

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	25	2.752	25	0	25	0	25	0	25	0	25
2		min	0	25	-3.77	25	0	25	0	25	0	25	0	25
3	P3-3C	max	0	25	1.904	25	0	25	0	25	0	25	0	25
4		min	0	25	-13.908	25	0	25	0	25	0	25	0	25
5	P2-3C	max	0	25	116.702	25	0	25	0	25	0	25	0	25
6		min	0	25	-7.467	25	0	25	0	25	0	25	0	25
7	P1-3C	max	0	25	154.343	25	0	25	0	25	0	25	0	25
8		min	0	25	-1.173	25	0	25	0	25	0	25	0	25
9	P7-3A	max	0	25	133.493	25	0	25	0	25	0	25	0	25
10		min	0	25	-14.375	25	0	25	0	25	0	25	0	25
11	P6-3A-FTG	max	0	25	159.648	25	0	25	0	25	0	25	0	25
12		min	0	25	-9.996	25	0	25	0	25	0	25	0	25
13	P5-3A-FTG	max	0	25	133.597	25	0	25	0	25	0	25	0	25
14		min	0	25	-8.154	25	0	25	0	25	0	25	0	25
15	P4-3A-FTG	max	0	25	0	25	0	25	0	25	0	25	0	25
16		min	0	25	0	25	0	25	0	25	0	25	0	25
17	P4-3A	max	0	25	134.369	25	0	25	0	25	0	25	193.837	25
18		min	0	25	-8.363	25	0	25	0	25	0	25	-237.716	25
19	P3-3A-FTG	max	0	25	121.635	25	0	25	0	25	0	25	0	25
20		min	0	25	-9.001	25	0	25	0	25	0	25	0	25
21	P2-3A	max	0	25	120.04	25	0	25	0	25	0	25	0	25
22		min	0	25	-7.624	25	0	25	0	25	0	25	0	25
23	P1-3A	max	0	25	72.993	25	0	25	0	25	0	25	0	25
24		min	0	25	-6.615	25	0	25	0	25	0	25	0	25
25	H5	max	0	25	0	25	0	25	0	25	0	25	0	25
26		min	0	25	0	25	0	25	0	25	0	25	0	25
27	Totals:	max	0	25	207	25	0	25						
28		min	0	25	15	25	0	25						

132.025
 +1 131.495
 -1 132.025
 -1 132.513
 -1 -132.426
 -2 -133.667
 -1 -133.936
 -1 -134.148
 -1 -134.295
 -1 -134.368
 -5 -134.377

3.025
 -1 -3.004
 -2 -15.93
 -2 -30.694
 -3 -57.194
 -4 -97.04
 -4 -138.04
 -4 -172.068
 -6 -211.9
 -2 -221.84
 -1 -225.746
 -3 -234.135
 -1 -235.898
 -3 -237.723

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Mar 22, 2010
 9:53 AM
 Checked By: CJM

Permit - P413 - track

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	26	2.922	26	0	26	0	26	0	26	0	26
2		min	0	26	-388	26	0	26	0	26	0	26	0	26
3	P3-3C	max	0	26	1.963	26	0	26	0	26	0	26	0	26
4		min	0	26	-14.766	26	0	26	0	26	0	26	0	26
5	P2-3C	max	0	26	116.308	26	0	26	0	26	0	26	0	26
6		min	0	26	-7.699	26	0	26	0	26	0	26	0	26
7	P1-3C	max	0	26	168.959	26	0	26	0	26	0	26	0	26
8		min	0	26	-1.123	26	0	26	0	26	0	26	0	26
9	P7-3A	max	0	26	143.431	26	0	26	0	26	0	26	0	26
10		min	0	26	-15.246	26	0	26	0	26	0	26	0	26
11	P6-3A-FTG	max	0	26	177.033	26	0	26	0	26	0	26	0	26
12		min	0	26	-9.983	26	0	26	0	26	0	26	0	26
13	P5-3A-FTG	max	0	26	143.344	26	0	26	0	26	0	26	0	26
14		min	0	26	-8.593	26	0	26	0	26	0	26	0	26
15	P4-3A-FTG	max	0	26	0	26	0	26	0	26	0	26	0	26
16		min	0	26	0	26	0	26	0	26	0	26	0	26
17	P4-3A	max	0	26	138.425	26	0	26	0	26	0	26	203.245	26
18		min	0	26	-9.122	26	0	26	0	26	0	26	-245.634	26
19	P3-3A-FTG	max	0	26	125.425	26	0	26	0	26	0	26	0	26
20		min	0	26	-8.647	26	0	26	0	26	0	26	0	26
21	P2-3A	max	0	26	122.065	26	0	26	0	26	0	26	0	26
22		min	0	26	-7.689	26	0	26	0	26	0	26	0	26
23	P1-3A	max	0	26	74.697	26	0	26	0	26	0	26	0	26
24		min	0	26	-7.007	26	0	26	0	26	0	26	0	26
25	H5	max	0	26	0	26	0	26	0	26	0	26	0	26
26		min	0	26	0	26	0	26	0	26	0	26	0	26
27	Totals:	max	0	26	255	26	0	26						
28		min	0	26	15	26	0	26						

137.403
 +.5 137.583
 +.5 137.746
 +1 138.014
 +1 138.209
 +1 138.341
 +1 138.414
 +1 138.424

-192.98 +1 -240.602
 +6 -225.58 +1 -240.18
 +1 -229.81 +1 -239.22
 +4 -238.50 error +1 -237.702
 +1 -241.8
 +4 -240.21 -1 -243.6
 +2 -237.74 -1 -244.85
 -3 -240.61 -1 -245.51
 -1 -240.487 -1.08 -245.57
 -1 -1.5 -245.68
 -6.96 = -223.854
 +1 -227.838
 +1 -231.322
 +1 -234.287
 +1 -236.708
 +1 -238.566
 +1 -239.838
 +1 -240.502

Permit - Std - C152B

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	27	3.122	27	0	27	0	27	0	27	0	27
2		min	0	27	-4.34	27	0	27	0	27	0	27	0	27
3	P3-3C	max	0	27	2.193	27	0	27	0	27	0	27	0	27
4		min	0	27	-15.774	27	0	27	0	27	0	27	0	27
5	P2-3C	max	0	27	123.945	27	0	27	0	27	0	27	0	27
6		min	0	27	-8.602	27	0	27	0	27	0	27	0	27
7	P1-3C	max	0	27	138.746	27	0	27	0	27	0	27	0	27
8		min	0	27	-1.526	27	0	27	0	27	0	27	0	27
9	P7-3A	max	0	27	128.539	27	0	27	0	27	0	27	0	27
10		min	0	27	-16.158	27	0	27	0	27	0	27	0	27
11	P6-3A-FTG	max	0	27	139.922	27	0	27	0	27	0	27	0	27
12		min	0	27	-12.096	27	0	27	0	27	0	27	0	27
13	P5-3A-FTG	max	0	27	128.513	27	0	27	0	27	0	27	0	27
14		min	0	27	-10.815	27	0	27	0	27	0	27	0	27
15	P4-3A-FTG	max	0	27	0	27	0	27	0	27	0	27	0	27
16		min	0	27	0	27	0	27	0	27	0	27	0	27
17	P4-3A	max	0	27	131.941	27	0	27	0	27	0	27	248.211	27
18		min	0	27	-10.542	27	0	27	0	27	0	27	-273.36	27
19	P3-3A-FTG	max	0	27	126.255	27	0	27	0	27	0	27	0	27
20		min	0	27	-9.623	27	0	27	0	27	0	27	0	27
21	P2-3A	max	0	27	126.03	27	0	27	0	27	0	27	0	27
22		min	0	27	-9.552	27	0	27	0	27	0	27	0	27
23	P1-3A	max	0	27	73.807	27	0	27	0	27	0	27	0	27
24		min	0	27	-8.453	27	0	27	0	27	0	27	0	27
25	H5	max	0	27	0	27	0	27	0	27	0	27	0	27
26		min	0	27	0	27	0	27	0	27	0	27	0	27
27	Totals:	max	0	27	152.2	27	0	27						
28		min	0	27	16	27	0	27						

131.944

- 260.58

+1 - 264.279

+2 - 269.958

+2 - 273.01

+1.5 - 273.321

+1.5 - 273.42

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Mar 22, 2010
 9:54 AM
 Checked By: CSM

Permit - Std - C174B

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	28	3.27	28	0	28	0	28	0	28	0	28
2		min	0	28	-4.23	28	0	28	0	28	0	28	0	28
3	P3-3C	max	0	28	2.139	28	0	28	0	28	0	28	0	28
4		min	0	28	-16.522	28	0	28	0	28	0	28	0	28
5	P2-3C	max	0	28	129.286	28	0	28	0	28	0	28	0	28
6		min	0	28	-8.388	28	0	28	0	28	0	28	0	28
7	P1-3C	max	0	28	152.775	28	0	28	0	28	0	28	0	28
8		min	0	28	-1.558	28	0	28	0	28	0	28	0	28
9	P7-3A	max	0	28	138.601	28	0	28	0	28	0	28	0	28
10		min	0	28	-16.968	28	0	28	0	28	0	28	0	28
11	P6-3A-FTG	max	0	28	154.824	28	0	28	0	28	0	28	0	28
12		min	0	28	-11.846	28	0	28	0	28	0	28	0	28
13	P5-3A-FTG	max	0	28	138.574	28	0	28	0	28	0	28	0	28
14		min	0	28	-11.041	28	0	28	0	28	0	28	0	28
15	P4-3A-FTG	max	0	28	0	28	0	28	0	28	0	28	0	28
16		min	0	28	0	28	0	28	0	28	0	28	0	28
17	P4-3A	max	0	28	143.186	28	0	28	0	28	0	28	234.298	28
18		min	0	28	-10.004	28	0	28	0	28	0	28	-267.086	28
19	P3-3A-FTG	max	0	28	135.693	28	0	28	0	28	0	28	0	28
20		min	0	28	-9.402	28	0	28	0	28	0	28	0	28
21	P2-3A	max	0	28	134.979	28	0	28	0	28	0	28	0	28
22		min	0	28	-9.089	28	0	28	0	28	0	28	0	28
23	P1-3A	max	0	28	70.121	28	0	28	0	28	0	28	0	28
24		min	0	28	-8.036	28	0	28	0	28	0	28	0	28
25	H5	max	0	28	0	28	0	28	0	28	0	28	0	28
26		min	0	28	0	28	0	28	0	28	0	28	0	28
27	Totals:	max	0	28	174	28	0	28						
28		min	0	28	14	28	0	28						

143.157

41 143.195

-251.508

-1 -256.275

-1 -260.182

-2 -265.327

-1/2 -267.015

-5 267.169

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Mar 22, 2010
 9:54 AM
 Checked By: *CTM*

Permit - Std - C198-23

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	29	3.129	29	0	29	0	29	0	29	0	29
2		min	0	29	-382	29	0	29	0	29	0	29	0	29
3	P3-3C	max	0	29	1.93	29	0	29	0	29	0	29	0	29
4		min	0	29	-15.811	29	0	29	0	29	0	29	0	29
5	P2-3C	max	0	29	128.011	29	0	29	0	29	0	29	0	29
6		min	0	29	-7.571	29	0	29	0	29	0	29	0	29
7	P1-3C	max	0	29	161.665	29	0	29	0	29	0	29	0	29
8		min	0	29	-1.403	29	0	29	0	29	0	29	0	29
9	P7-3A	max	0	29	142.866	29	0	29	0	29	0	29	0	29
10		min	0	29	-16.276	29	0	29	0	29	0	29	0	29
11	P6-3A-FTG	max	0	29	165.566	29	0	29	0	29	0	29	0	29
12		min	0	29	-10.937	29	0	29	0	29	0	29	0	29
13	P5-3A-FTG	max	0	29	142.885	29	0	29	0	29	0	29	0	29
14		min	0	29	-9.897	29	0	29	0	29	0	29	0	29
15	P4-3A-FTG	max	0	29	0	29	0	29	0	29	0	29	0	29
16		min	0	29	0	29	0	29	0	29	0	29	0	29
17	P4-3A	max	0	29	147.224	29	0	29	0	29	0	29	201.609	29
18		min	0	29	-8.527	29	0	29	0	29	0	29	-239.448	29
19	P3-3A-FTG	max	0	29	136.956	29	0	29	0	29	0	29	0	29
20		min	0	29	-8.452	29	0	29	0	29	0	29	0	29
21	P2-3A	max	0	29	135.36	29	0	29	0	29	0	29	0	29
22		min	0	29	-7.892	29	0	29	0	29	0	29	0	29
23	P1-3A	max	0	29	71.961	29	0	29	0	29	0	29	0	29
24		min	0	29	-6.811	29	0	29	0	29	0	29	0	29
25	H5	max	0	29	0	29	0	29	0	29	0	29	0	29
26		min	0	29	0	29	0	29	0	29	0	29	0	29
27	Totals:	max	0	29	198	29	0	29						
28		min	0	29	14	29	0	29						

145.75
 -1 146.187
 -2 146.848
 -1 147.052
 -1 147.171
 -1 147.224

-212.618
 -2 -223.000
 -2 -230.627
 -1 -233.387
 -2 -237.384
 -1 -238.541
 -1 -238.953
 -1 -238.723
 +.5 238.900
 +.5 238.953
 +.5 238.038
 -1 238.723
 -1 -239.342
 -1 -239.447

Permit - Std - C214 B

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	30	3.055	30	0	30	0	30	0	30	0	30
2		min	0	30	-381	30	0	30	0	30	0	30	0	30
3	P3-3C	max	0	30	1.923	30	0	30	0	30	0	30	0	30
4		min	0	30	-15.436	30	0	30	0	30	0	30	0	30
5	P2-3C	max	0	30	124.478	30	0	30	0	30	0	30	0	30
6		min	0	30	-7.543	30	0	30	0	30	0	30	0	30
7	P1-3C	max	0	30	167.742	30	0	30	0	30	0	30	0	30
8		min	0	30	-1.325	30	0	30	0	30	0	30	0	30
9	P7-3A	max	0	30	147.102	30	0	30	0	30	0	30	0	30
10		min	0	30	-15.888	30	0	30	0	30	0	30	0	30
11	P6-3A-FTG	max	0	30	172.784	30	0	30	0	30	0	30	0	30
12		min	0	30	-10.284	30	0	30	0	30	0	30	0	30
13	P5-3A-FTG	max	0	30	147.183	30	0	30	0	30	0	30	0	30
14		min	0	30	-9.204	30	0	30	0	30	0	30	0	30
15	P4-3A-FTG	max	0	30	0	30	0	30	0	30	0	30	0	30
16		min	0	30	0	30	0	30	0	30	0	30	0	30
17	P4-3A	max	0	30	150.221	30	0	30	0	30	0	30	192.32	30
18		min	0	30	-8.2	30	0	30	0	30	0	30	-239.916	30
19	P3-3A-FTG	max	0	30	138.301	30	0	30	0	30	0	30	0	30
20		min	0	30	-8.602	30	0	30	0	30	0	30	0	30
21	P2-3A	max	0	30	136.256	30	0	30	0	30	0	30	0	30
22		min	0	30	-7.555	30	0	30	0	30	0	30	0	30
23	P1-3A	max	0	30	73.998	30	0	30	0	30	0	30	0	30
24		min	0	30	-6.52	30	0	30	0	30	0	30	0	30
25	H5	max	0	30	0	30	0	30	0	30	0	30	0	30
26		min	0	30	0	30	0	30	0	30	0	30	0	30
27	Totals:	max	0	30	214	30	0	30						
28		min	0	30	14	30	0	30						

148.06
 -2 149.015
 -2 149.715
 -2 150.127
 +.5 150.055
 -1 150.178
 -.5 150.209
 -.5 150.223

- 231.014
 +1 -228.553
 -1 -231.014
 -1 -232.964
 -1 -235.422
 -2 -238.6
 -1 -239.467
 -.5 -239.73
 -.5 -239.832
 -.5 -239.921

Permit - Std - C237B

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	31	2.807	31	0	31	0	31	0	31	0	31
2		min	0	31	-385	31	0	31	0	31	0	31	0	31
3	P3-3C	max	0	31	1.946	31	0	31	0	31	0	31	0	31
4		min	0	31	-14.184	31	0	31	0	31	0	31	0	31
5	P2-3C	max	0	31	118.844	31	0	31	0	31	0	31	0	31
6		min	0	31	-7.633	31	0	31	0	31	0	31	0	31
7	P1-3C	max	0	31	167.622	31	0	31	0	31	0	31	0	31
8		min	0	31	-1.152	31	0	31	0	31	0	31	0	31
9	P7-3A	max	0	31	143.156	31	0	31	0	31	0	31	0	31
10		min	0	31	-15.15	31	0	31	0	31	0	31	0	31
11	P6-3A-FTG	max	0	31	174.594	31	0	31	0	31	0	31	0	31
12		min	0	31	-9.873	31	0	31	0	31	0	31	0	31
13	P5-3A-FTG	max	0	31	143.226	31	0	31	0	31	0	31	0	31
14		min	0	31	-8.326	31	0	31	0	31	0	31	0	31
15	P4-3A-FTG	max	0	31	0	31	0	31	0	31	0	31	0	31
16		min	0	31	0	31	0	31	0	31	0	31	0	31
17	P4-3A	max	0	31	142.248	31	0	31	0	31	0	31	196.017	31
18		min	0	31	-8.653	31	0	31	0	31	0	31	-243.426	31
19	P3-3A-FTG	max	0	31	127.948	31	0	31	0	31	0	31	0	31
20		min	0	31	-8.948	31	0	31	0	31	0	31	0	31
21	P2-3A	max	0	31	125.263	31	0	31	0	31	0	31	0	31
22		min	0	31	-7.514	31	0	31	0	31	0	31	0	31
23	P1-3A	max	0	31	74.637	31	0	31	0	31	0	31	0	31
24		min	0	31	-6.735	31	0	31	0	31	0	31	0	31
25	H5	max	0	31	0	31	0	31	0	31	0	31	0	31
26		min	0	31	0	31	0	31	0	31	0	31	0	31
27	Totals:	max	0	31	237.4	31	0	31						
28		min	0	31	13	31	0	31						

140,785

-2 141.468

-2 141.946

-2 142.214

-1 142.248

-237.136

+5 -235.689

-5 -237.136

-1 -239.51

-2 -242.497

-1 -243.209

-5 -243.378

-5 -243.426

Permit - Std - C256B

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	32	2.967	32	0	32	0	32	0	32	0	32
2		min	0	32	-394	32	0	32	0	32	0	32	0	32
3	P3-3C	max	0	32	1.993	32	0	32	0	32	0	32	0	32
4		min	0	32	-14.994	32	0	32	0	32	0	32	0	32
5	P2-3C	max	0	32	116.871	32	0	32	0	32	0	32	0	32
6		min	0	32	-7.817	32	0	32	0	32	0	32	0	32
7	P1-3C	max	0	32	168.716	32	0	32	0	32	0	32	0	32
8		min	0	32	-1.13	32	0	32	0	32	0	32	0	32
9	P7-3A	max	0	32	142.878	32	0	32	0	32	0	32	0	32
10		min	0	32	-15.278	32	0	32	0	32	0	32	0	32
11	P6-3A-FTG	max	0	32	176.736	32	0	32	0	32	0	32	0	32
12		min	0	32	-9.941	32	0	32	0	32	0	32	0	32
13	P5-3A-FTG	max	0	32	142.832	32	0	32	0	32	0	32	0	32
14		min	0	32	-8.771	32	0	32	0	32	0	32	0	32
15	P4-3A-FTG	max	0	32	0	32	0	32	0	32	0	32	0	32
16		min	0	32	0	32	0	32	0	32	0	32	0	32
17	P4-3A	max	0	32	137.528	32	0	32	0	32	0	32	207.254	32
18		min	0	32	-9.296	32	0	32	0	32	0	32	-249.587	32
19	P3-3A-FTG	max	0	32	124.479	32	0	32	0	32	0	32	0	32
20		min	0	32	-8.969	32	0	32	0	32	0	32	0	32
21	P2-3A	max	0	32	121.693	32	0	32	0	32	0	32	0	32
22		min	0	32	-7.801	32	0	32	0	32	0	32	0	32
23	P1-3A	max	0	32	73.99	32	0	32	0	32	0	32	0	32
24		min	0	32	-7.154	32	0	32	0	32	0	32	0	32
25	H5	max	0	32	0	32	0	32	0	32	0	32	0	32
26		min	0	32	0	32	0	32	0	32	0	32	0	32
27	Totals:	max	0	32	256	32	0	32						
28		min	0	32	16	32	0	32						

137.155

+ .5 137.059

- .5 137.155

-1 137.311

-1 137.431

-1 137.506

-1 137.528

-1 137.485

- 249.585

+ .5 -249.47

- .5 -249.585

- .5 -249.553

+ .5 -249.592

Company : LHB
 Designer : jdf
 Job Number : 090147

Pier 4,5,6-3A, Girder A and Beam A, Live Loads

Mar 22, 2010
 10:01 AM
 Checked By: *CJH*

Permit - Std - C200 J

5/6/10

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	H1	max	0	33	3.361	33	0	33	0	33	0	33	0	33
2		min	0	33	-4.23	33	0	33	0	33	0	33	0	33
3	P3-3C	max	0	33	2.139	33	0	33	0	33	0	33	0	33
4		min	0	33	-16.982	33	0	33	0	33	0	33	0	33
5	P2-3C	max	0	33	128.179	33	0	33	0	33	0	33	0	33
6		min	0	33	-8.39	33	0	33	0	33	0	33	0	33
7	P1-3C	max	0	33	169.577	33	0	33	0	33	0	33	0	33
8		min	0	33	-1.55	33	0	33	0	33	0	33	0	33
9	P7-3A	max	0	33	154.822	33	0	33	0	33	0	33	0	33
10		min	0	33	-17.222	33	0	33	0	33	0	33	0	33
11	P6-3A-FTG	max	0	33	172.317	33	0	33	0	33	0	33	0	33
12		min	0	33	-9.376	33	0	33	0	33	0	33	0	33
13	P5-3A-FTG	max	0	33	154.176	33	0	33	0	33	0	33	0	33
14		min	0	33	-10.839	33	0	33	0	33	0	33	0	33
15	P4-3A-FTG	max	0	33	0	33	0	33	0	33	0	33	0	33
16		min	0	33	0	33	0	33	0	33	0	33	0	33
17	P4-3A	max	0	33	157.142 ²	33	0	33	0	33	0	33	222.289	33
18		min	0	33	-9.325	33	0	33	0	33	0	33	-265.908 ²	33
19	P3-3A-FTG	max	0	33	149.087	33	0	33	0	33	0	33	0	33
20		min	0	33	-9.359	33	0	33	0	33	0	33	0	33
21	P2-3A	max	0	33	147.268	33	0	33	0	33	0	33	0	33
22		min	0	33	-8.298	33	0	33	0	33	0	33	0	33
23	P1-3A	max	0	33	76.623	33	0	33	0	33	0	33	0	33
24		min	0	33	-7.472	33	0	33	0	33	0	33	0	33
25	H5	max	0	33	0	33	0	33	0	33	0	33	0	33
26		min	0	33	0	33	0	33	0	33	0	33	0	33
27	Totals:	max	0	33	200	33	0	33						
28		min	0	33	20	33	0	33						

155.527
 -1 155.559
 -1 155.495

157.091
 +1 157.146

-265.927



21 West Superior Street, Suite 500
Duluth, Minnesota 55802
218 727-8446
Fax 218 727-8456
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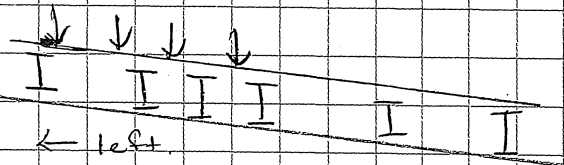
250 3rd Avenue North, Suite 450
Minneapolis, Minnesota 55401
612 338-2029
Fax 612 338-2088

PROJECT MnDOT SS-69801J-P6-3A-Posting + Permit Trucks - Moment
PROJECT # 090147 DATE 4/14/10 BY jdf SHEET NO. _____ OF _____

The truck location to cause maximum moment varies with the magnitudes of the trucks.

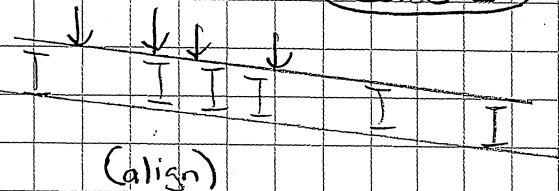
- When trucks match or are close in weight.

Case 1



- When one truck is heavier

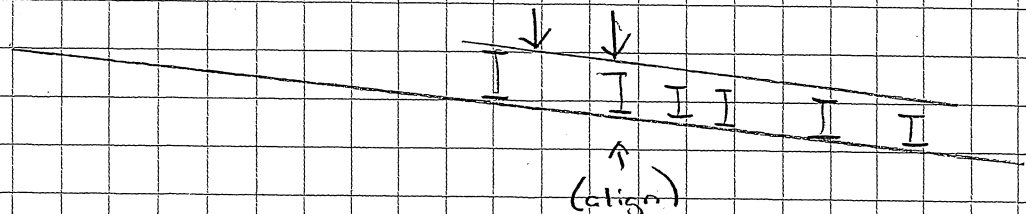
Case 2



Therefore the Type 352-40 + SU7 and 333 + SU7 are case ① while the rest of the posting and permit calculations are case ②

Two lanes of trucks always controls moment, even w/ the 1.2 multiple presence factor with only one lane loaded.

The truck location when only one truck is used was determined.



DD-21

Jennifer French

From: Gao, Yihong (DOT) [Yihong.Gao@state.mn.us]
Sent: Thursday, March 18, 2010 4:30 PM
To: Jon Siiter
Cc: Jennifer French; Johnson, Lowell (DOT); Dimaculangan, Moises (DOT)
Subject: RE: MnDOT SS - Bridge 69801 Design, Legal, and Permit Live Load Factors

Jon,
Yes, I think these live load factors are consistent with what we use for superstructures. As for next lane loading, I think we will still use full legal loads not taking 75% of the weight considering the truck weight could have up to 5% tolerance.

Thanks,

Yihong



Yihong Gao, PE
Bridge Rating Engineer
MnDOT Bridge Office
3485 Hadley Avenue N.
Oakdale, MN 55128-3307
TEL: 651-366-4492
EMAIL: yihong.gao@state.mn.us

From: Jon Siiter [mailto:Jon.Siiter@lhbcorp.com]
Sent: Wednesday, March 17, 2010 4:15 PM
To: Gao, Yihong (DOT)
Cc: Jennifer French
Subject: FW: MnDOT SS - Bridge 69801 Design, Legal, and Permit Live Load Factors

Yihong, please see attached e-mail for input we received from the author of the Manual for Bridge Evaluation. You will see that there are not explicit rules for load factors when rating piers. We believe the summary Jen gives below is appropriate, except that we would not be using 1.15 for any of the standard permit trucks since they are not single trip vehicles. Any input you may have or concurrence would be appreciated. Thanks.

From: Jennifer French
Sent: Wednesday, March 17, 2010 3:36 PM
To: Jon Siiter
Cc: Jennifer French
Subject: MnDOT SS - Bridge 69801 Design, Legal, and Permit Live Load Factors

Jon, I've contacted Bala Sivakumar who wrote the Manual for Bridge Evaluation. With his input (see the email string below), I propose the following Live Load Factors. Bala's credentials are located in the attached PDF.

- Design: Inventory of 1.75 and Operating of 1.35
- Legal/Posting: 1.35
- Permit for routine and multiple trips: 1.35
- Permit for single trips: 1.15 (using permit and legal trucks when not escorted, using only permit truck when escorted).

What are your thoughts?
Jen

From: Bala Sivakumar [mailto:bsivakumar@HNTB.com]
Sent: Wednesday, March 17, 2010 3:14 PM
To: Jennifer French
Subject: RE: MnDOT SS - Bridge 69801 Permit Load Factors

My comments below. Good luck

Bala Sivakumar, P.E.
Vice President
Director-Special Bridge Projects

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6th Floor
New York, NY 10001-1810

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From: Jennifer French [mailto:Jennifer.French@lhbcorp.com]
Sent: Wednesday, March 17, 2010 2:06 PM
To: Bala Sivakumar
Cc: Jennifer French
Subject: RE: MnDOT SS - Bridge 69801 Permit Load Factors

Bala, thank you for talking with me on the phone. As I mentioned, I will try to summarize our conversation here to verify that I have collected your thoughts correctly. A reply with any revisions would be appreciated.

Background:

- There have not been calibration studies for Substructure elements.
- Load Factors in the MBE pertain to longitudinal superstructure elements using LRFD distribution factors not lever rule.
- The MBE live load factors are calibrated based on the likelihood of side by side trucks, while a transverse substructure member would be affected more by direct loading and therefore is different.
- There is no guidance in the MBE for substructure review with legal or permit loads at this time. Planned for the future.
- Routine permits are not much different than heavy posting trucks in most states as they operate with no restrictions just like legal loads. For load rating purposes they may be considered the same – conservative assumption.
- Routine permits should be considered differently than special permits that operate in a more controlled fashion in terms of weight and number of trips.
- You (Bala) have been awarded a contract to review some of the issues I brought up below under an NCHRP 20-07 contract that will recalibrate LRFR load factors for permits for use with non LRFD distribution factor methods such as refined analysis.

Design Loading Recommendations:

- Use two lanes loaded with HL-93 loading.
- Use HL-93 loading with the 1.35 and 1.75 factors for operating and inventory, respectively.

Posting/Legal Truck Recommendations:

- Use one posting vehicle in one lane with one legal vehicle in the other.
- As the probability of loading is similar to HL-93 STRENGTH II case, use the comparable load factor of 1.35.

Routine Permit Truck Recommendations (and multiple trips):

- Use one permit truck in one lane with one legal vehicle in the other.
- Use the same load factor as for Posting trucks. Use load factor of 1.35.

Special Permit Truck Recommendations (single trips):

- Use one permit vehicle only or one permit vehicle in one lane with one legal vehicle in the other. A definite choice is not clear. Thoughts include:
 - Heavy permit truck in one lane with no truck in the second. This is most likely as the chance of a truck in the other lane is small. However this could be unconservative as a second truck could be occupying the second lane.
 - Heavy permit truck in one lane with legal truck in the second. Not likely, but possible.
 - Heavy permit truck in one lane with a 65 kip truck (approximately 80% of legal truck) in the second. More likely.
- Use a live load factor of 1.15 for these conditions. LRFR load factor for single trip special permits
- I (Jen) suggested using the 1.15 factor with a permit truck in one lane and legal truck in the other, and you (Bala) said that would be conservative and then suggested using the permit truck plus 80% of the legal truck loading.

I will be happy to send you a copy of this rating once it is completed as I understand you would like to use real-world design data for a project you have coming up. As mentioned in our conversation, I will have to ask MnDOT permission to send you this information.

Again, thank you for your time in reviewing my questions.

Jen

From: Jennifer French
Sent: Wednesday, March 17, 2010 11:20 AM
To: bsivakumar@hntb.com
Cc: Jennifer French
Subject: FW: MnDOT SS - Bridge 69801 Permit Load Factors

Bala, thank you for taking the time to consider this email. I called and left a message that I would be sending you this question.

I am rating a fracture critical integral steel box-beam pier cap at a highway interchange here in Duluth. I have been following the Manual for Bridge Evaluation F (First Edition/2008) as well as the AASHTO LRFD Bridge Design Specification (With revisions through 2009).

I am looking for some input/advice on what live load factors should be used for the permit and posting trucks when using LRFR for fracture critical piers (Substructure).

In section 6A.1.8.2 Substructures: It states "load rating of substructure elements should be done using the Strength I load combination and load factors of LRFD Design Article 3.4.1, including all...." To me this means that the live load factor would be 1.75 for design, legal, and permit ratings. Is this correct? If not, should we use the Tables in 6A.4.2.3 through 6A.4.2.5? I am concerned about using the values from these tables due to their values being based on the Lane Distribution Factors as all of my load distribution has been done using simple statics like the lever rule.

Some background on the pier cap:

- It was designed in 1966 using ASD.
- We have been requested to use LRFR for rating.

- It supports 2 lanes.
- Under design loads, the rating factor is below 1.0. (Using live load factors of 1.35 and 1.75)
- We will be designing a reinforcement scheme.
- The ADTT is 1050.
- When running the permit trucks, I have been instructed to run one permit truck with one legal truck in the other lane.
- When running the posting trucks, I have been instructed to run one posting truck with the worst legal truck in the other lane.

I appreciate your help. Please feel free to call me at the number below if you have questions.

Thanks,

Jen French

Jennifer French, PE (MN, MI)
Senior Structural Engineer
LHB
21 West Superior Street, Suite 500
Duluth, MN 55802
Direct Dial: 218-279-2461

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MnDOT Special Structures, 69801J
Pier Cap P6-3A Reactions under posting and permit loads
21-May-10

				HL-93 CF Pier				HL-93 Braking				Mx DL		phi (s) =		phi (s) =	
				Reaction (kip)				Force (Kip)				(kip*ft)		Sx (in^3)		Sy (in^3)	
				141.2				36				6148.7		5541.61		171608	
														1882.83			

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

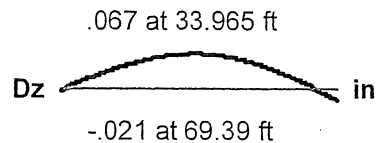
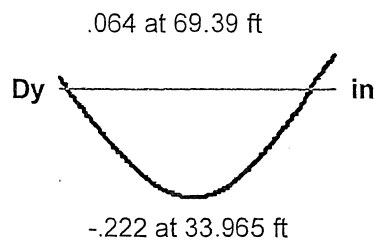
I Joint: **N1**

J Joint: **N4**

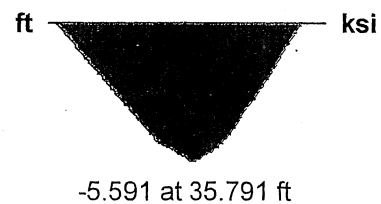
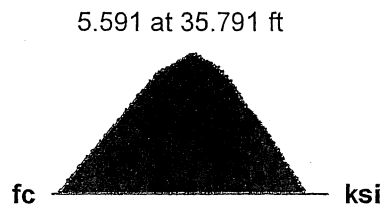
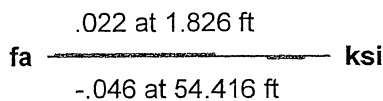
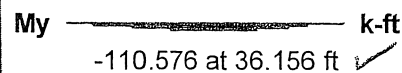
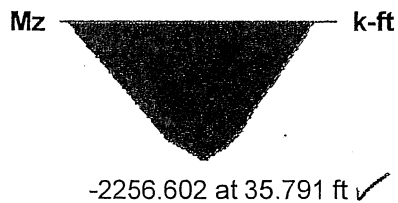
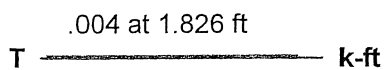
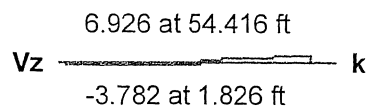
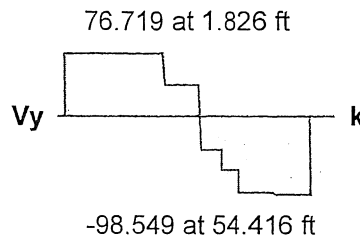
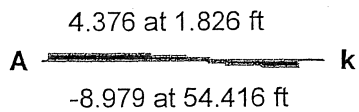
LC 5: Mom Type 3 + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



✓com
\$initial
5/10/10
recheck
6/24/10



Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

I Joint: **N1**

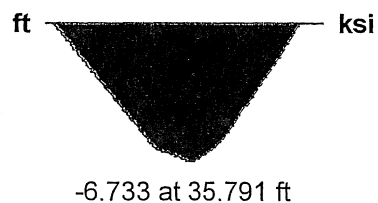
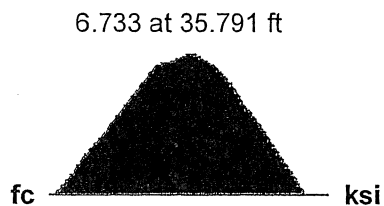
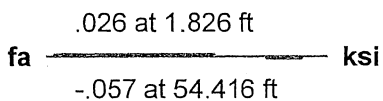
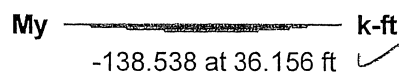
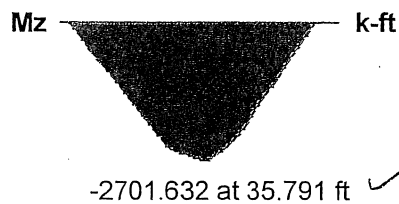
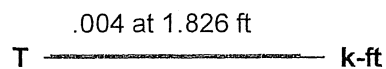
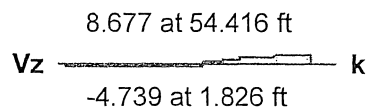
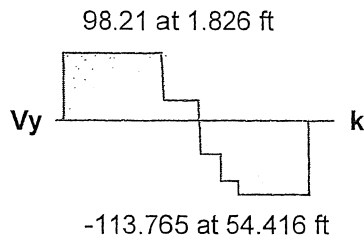
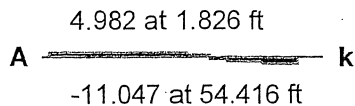
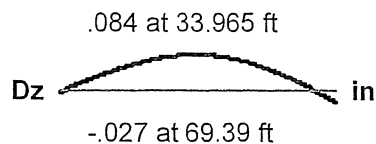
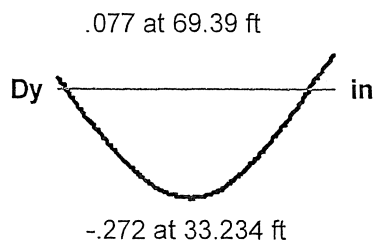
J Joint: **N4**

LC 6: Mom Type 3S2-40 + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections

✓ JTM
initial
5/10/10
recheck
Calzutto



Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

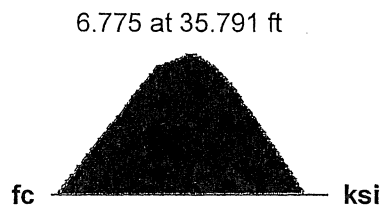
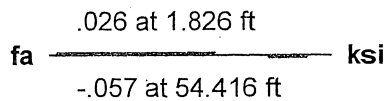
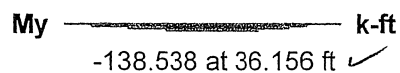
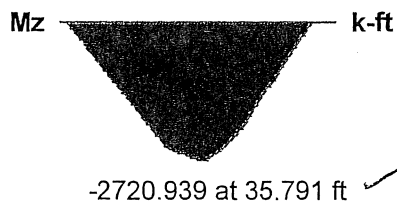
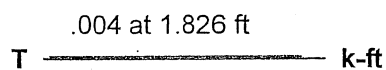
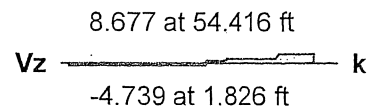
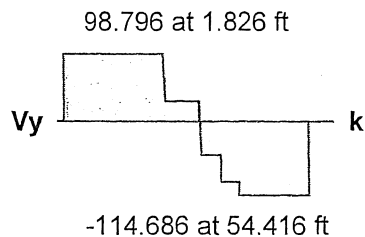
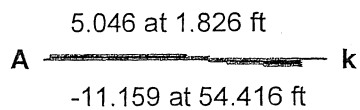
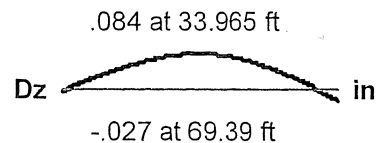
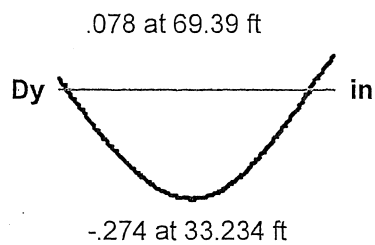
I Joint: **N1**

J Joint: **N4**

LC 7: Mom Type 3S3 +SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



✓COM
Initial check
Sholio
recheck
6/24/10

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

I Joint: **N1**

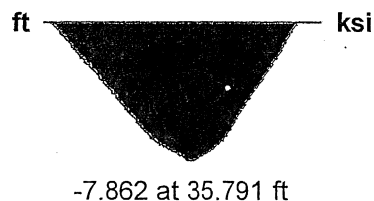
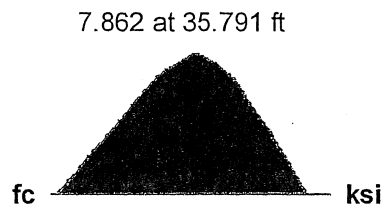
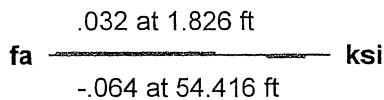
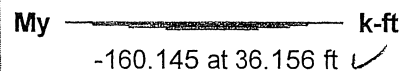
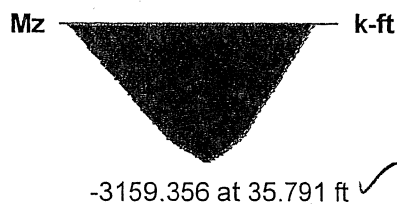
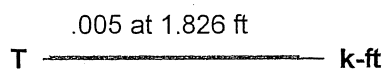
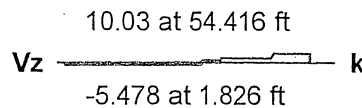
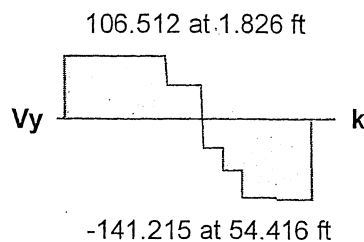
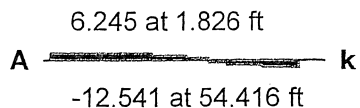
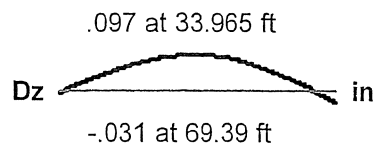
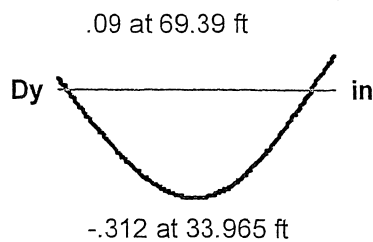
J Joint: **N4**

LC 8: Mom Std A + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections

VCTM
initial
S/10/10
recheck
6/24/10



Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

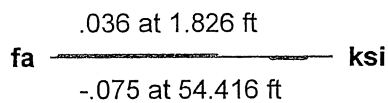
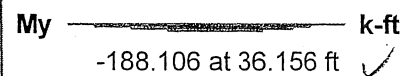
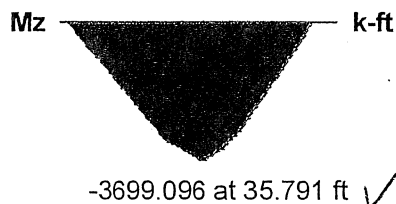
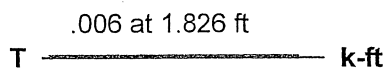
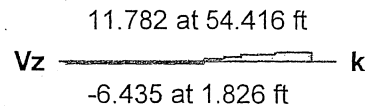
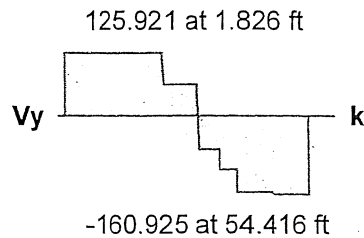
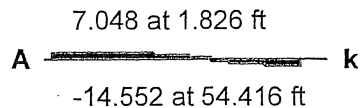
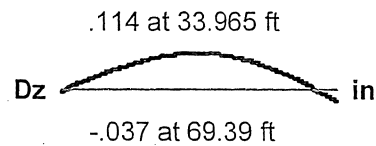
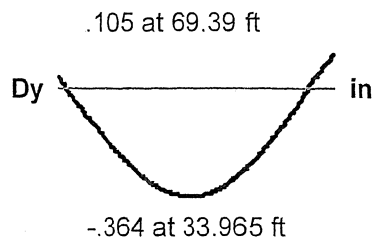
I Joint: **N1**

J Joint: **N4**

LC 9: **Mom Std B + SU7**

Code Check: **0.000 (bending)**

Report Based On 191 Sections



✓com
initial
5/10/10
recheck
6/24/10

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

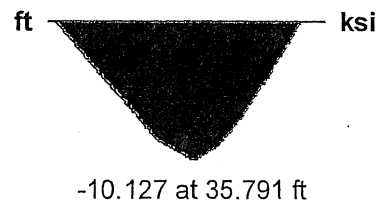
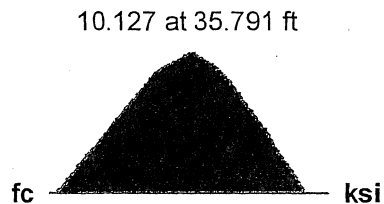
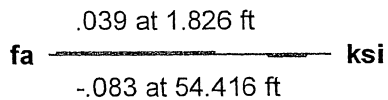
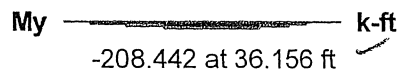
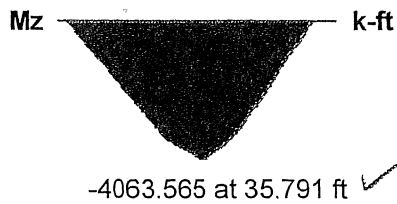
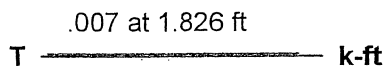
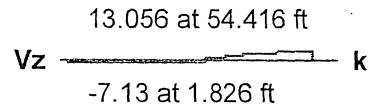
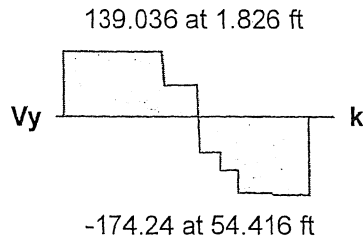
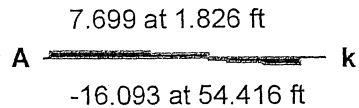
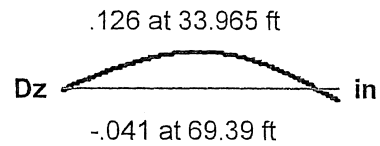
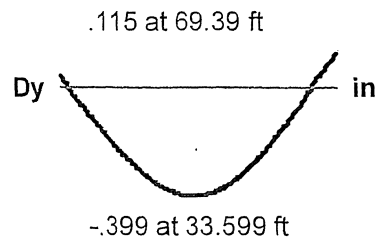
I Joint: **N1**

J Joint: **N4**

LC 10: Mom Std C +SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



VCOM
Initial
5/10/10
recheck
6/24/10

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

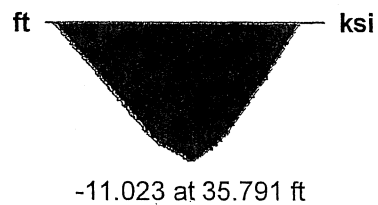
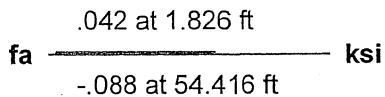
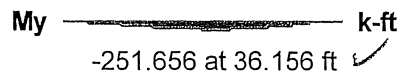
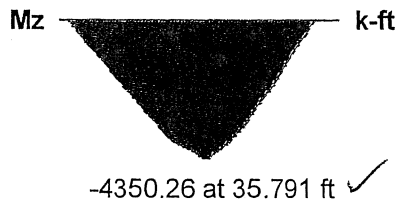
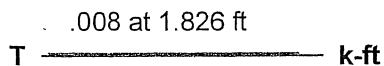
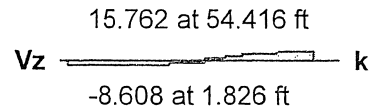
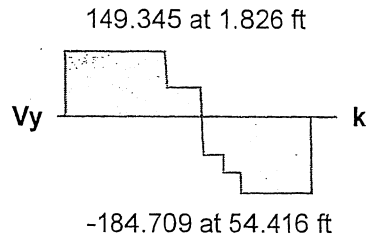
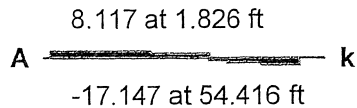
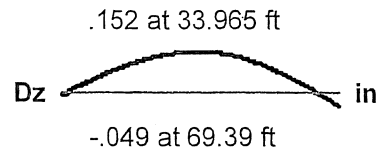
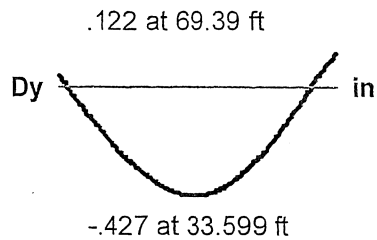
I Joint: **N1**

J Joint: **N4**

LC 11: Mom P411 + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



UCM
initial
5/10/10
recheck
6/2/10

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

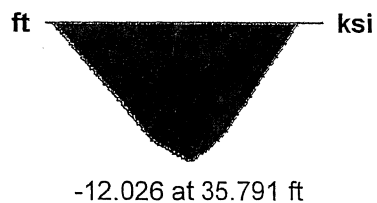
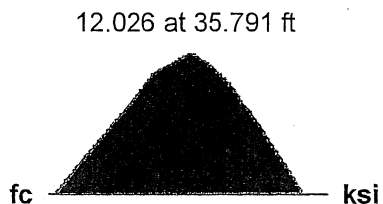
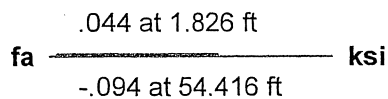
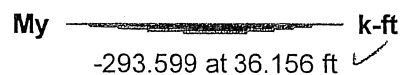
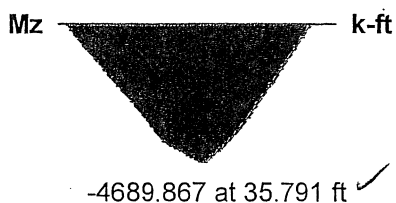
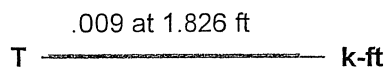
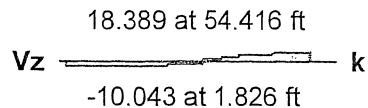
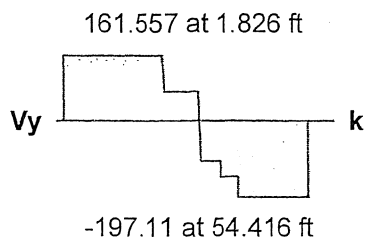
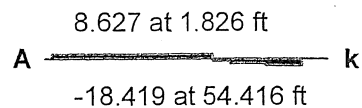
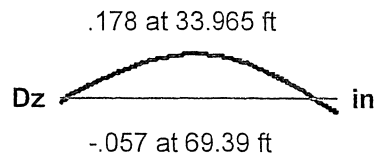
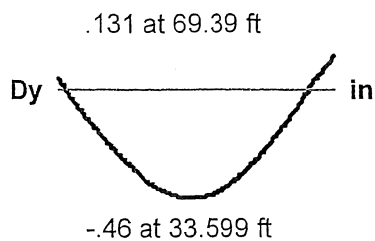
I Joint: **N1**

J Joint: **N4**

LC 12: Mom P413 + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



UJTM
initial
slit/slo
recheck
6/24/10

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

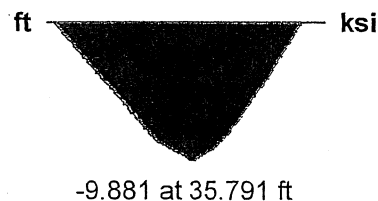
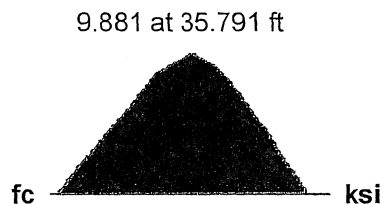
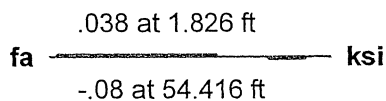
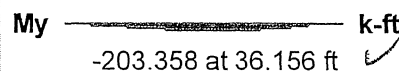
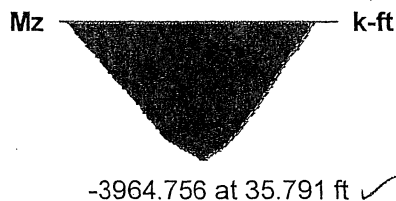
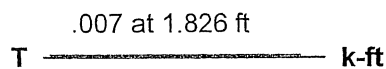
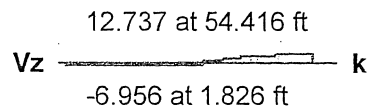
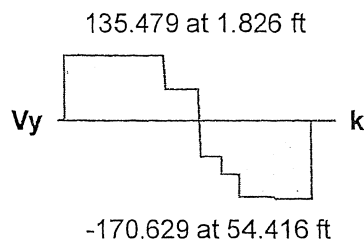
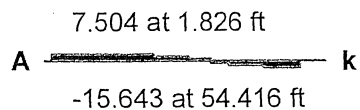
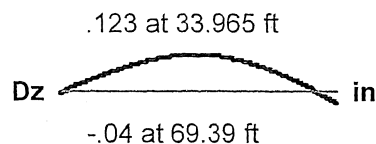
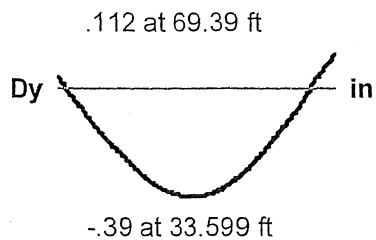
I Joint: **N1**

J Joint: **N4**

LC 13: Mom Std C152b + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



UCJM
initial
5/10/10
recheck
6/24/10

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

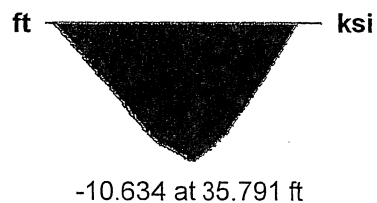
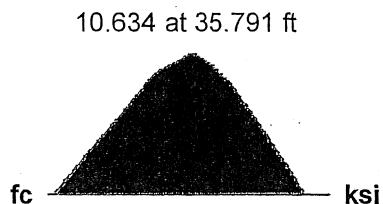
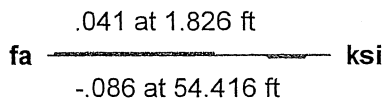
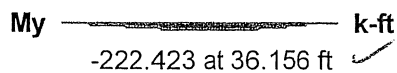
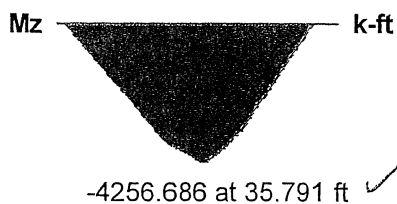
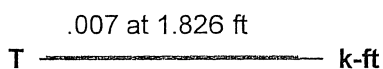
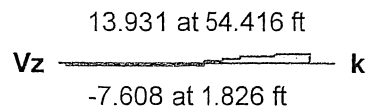
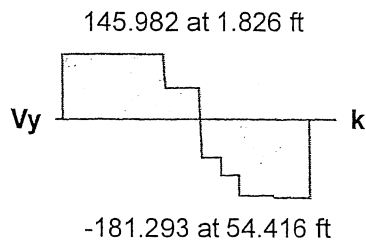
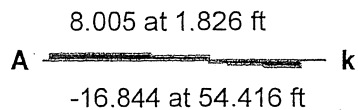
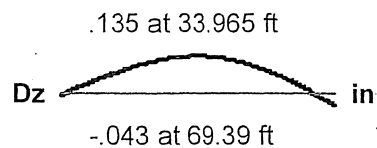
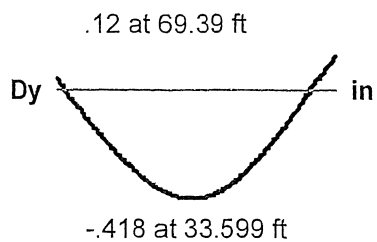
I Joint: **N1**

J Joint: **N4**

LC 14: Mom Std C174b + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



dim
initial
Sho/h
recte/c
6/20/10

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

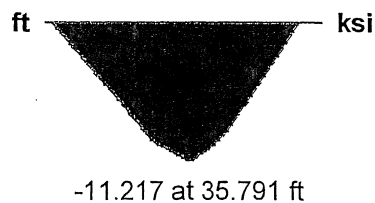
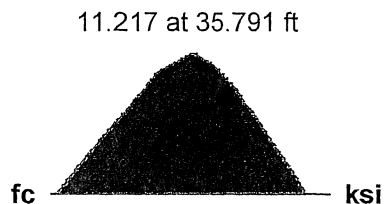
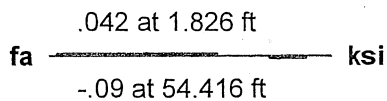
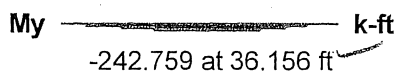
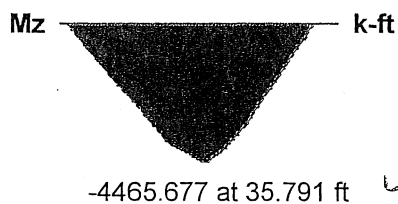
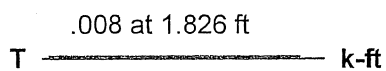
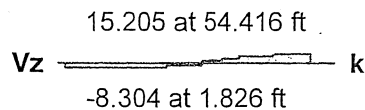
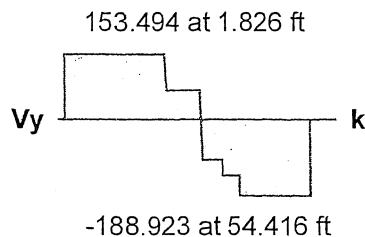
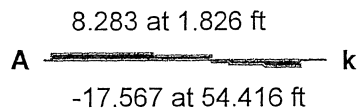
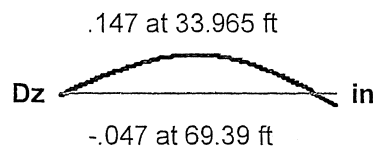
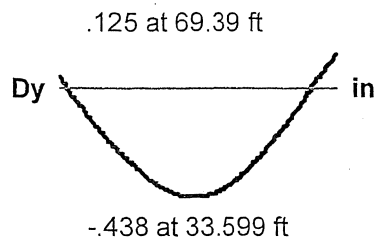
I Joint: **N1**

J Joint: **N4**

LC 15: Mom Std C198_23 + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



VCJM
initial
5/10/10
recteck
6/24/10

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

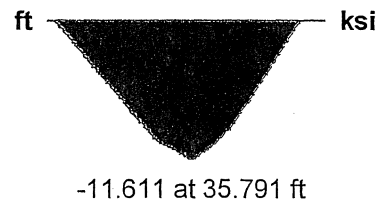
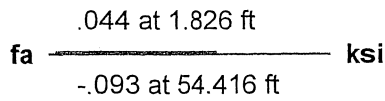
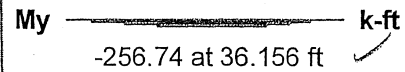
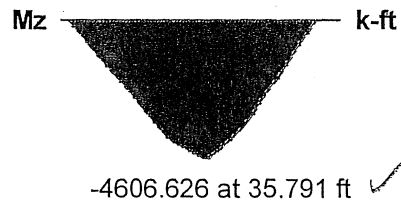
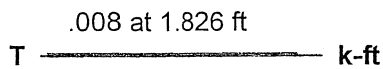
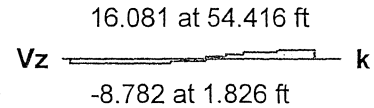
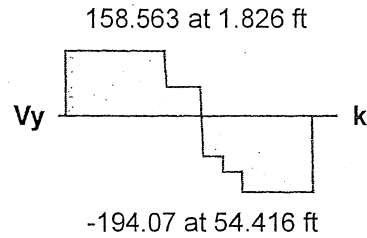
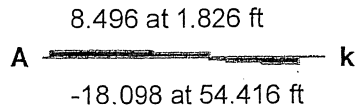
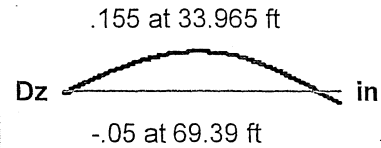
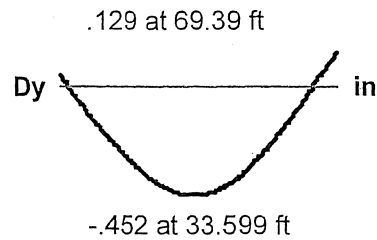
I Joint: **N1**

J Joint: **N4**

LC 16: Mom Std 214b + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



kgm
initial
5/10/10
recheck
Gladys

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

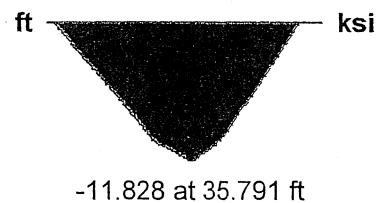
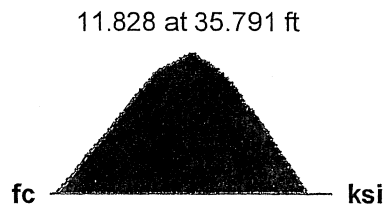
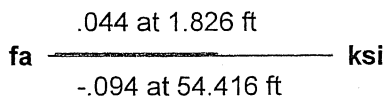
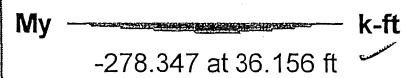
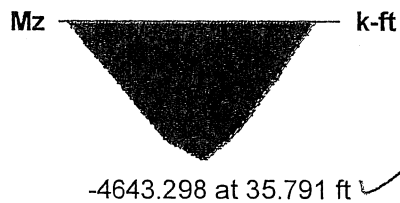
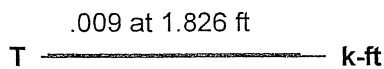
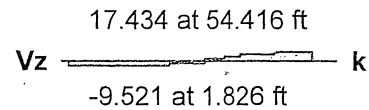
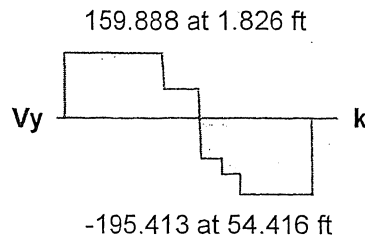
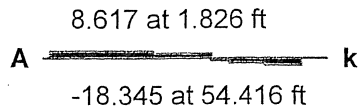
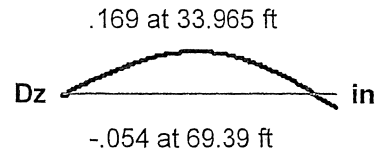
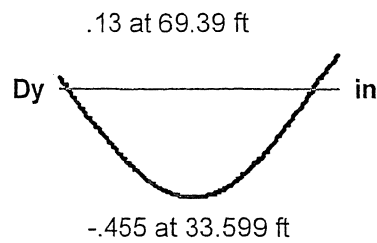
I Joint: **N1**

J Joint: **N4**

LC 17: **Mom Std C237b + SU7**

Code Check: **0.000 (bending)**

Report Based On 191 Sections



dcjm
initial
Sketch
recheck
6/24/10

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

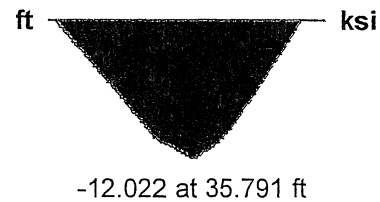
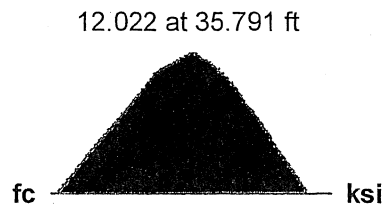
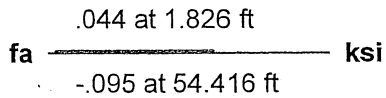
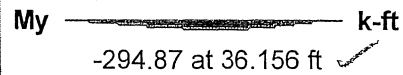
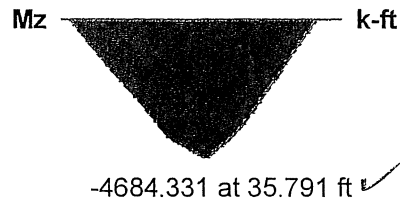
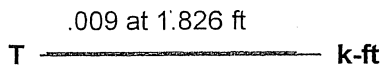
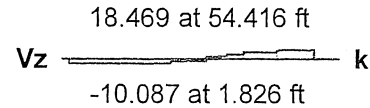
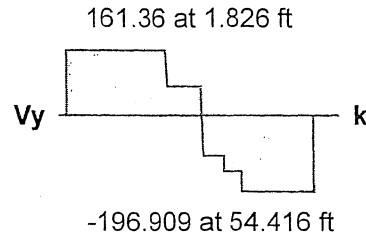
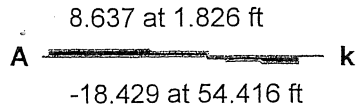
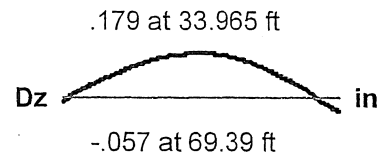
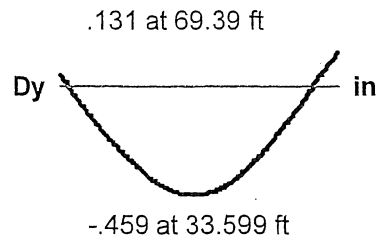
I Joint: **N1**

J Joint: **N4**

LC 18: Mom Std C256b + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



✓JM
initial
5/10/10
rechecked
6/24/10

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

I Joint: **N1**

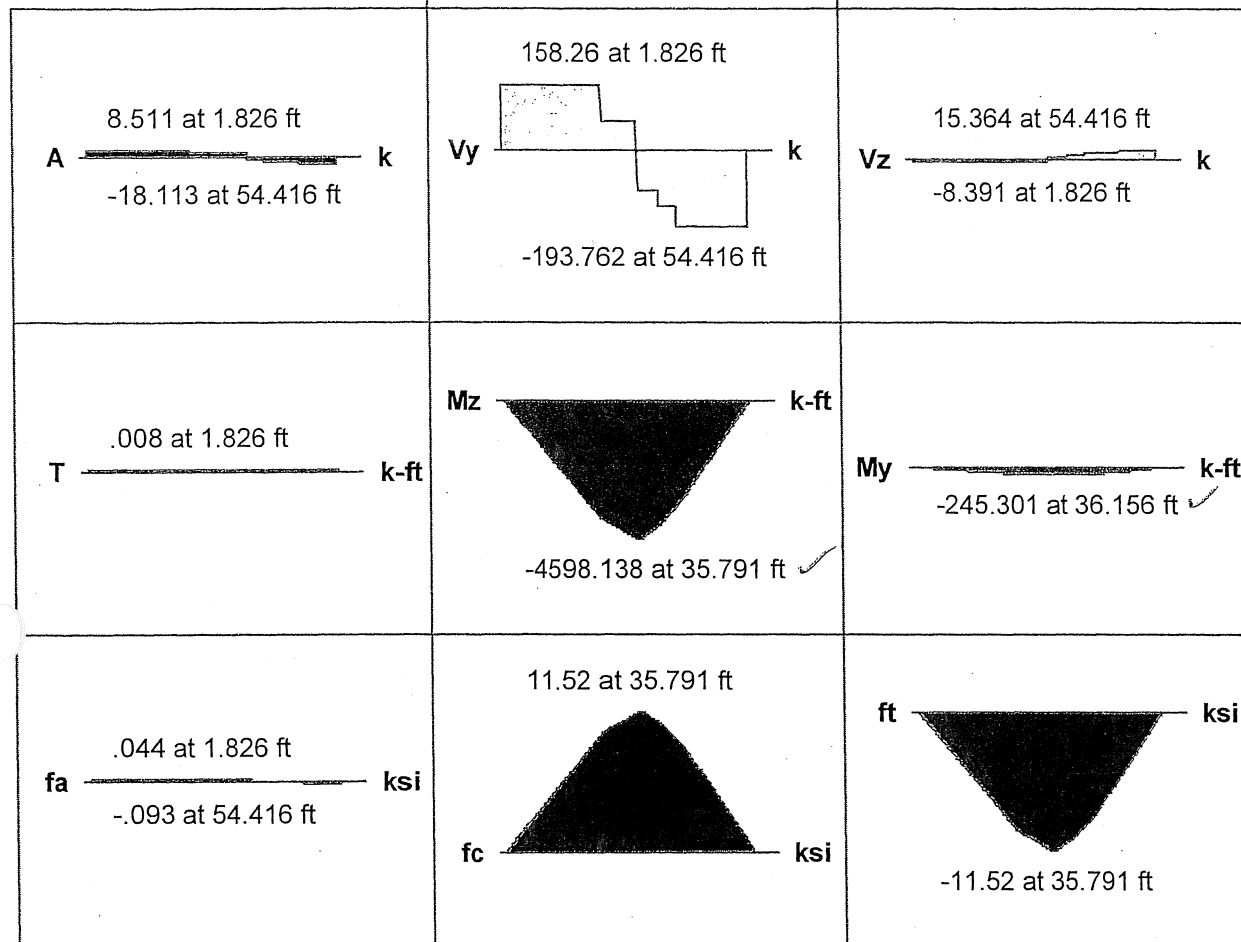
J Joint: **N4**

LC 19: Mom Std C200j + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections

VCJM
initial
S/10/10
recheck
Giblio



Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

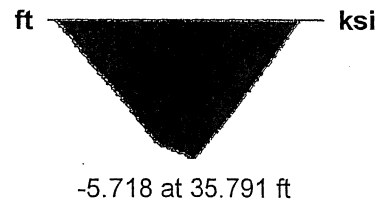
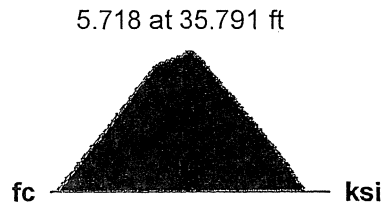
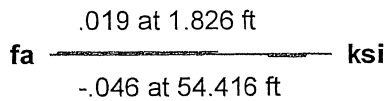
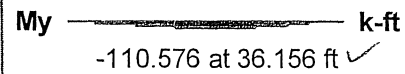
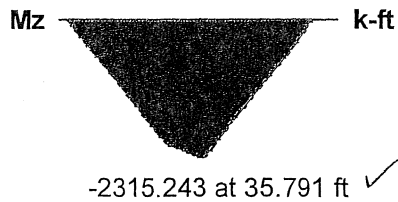
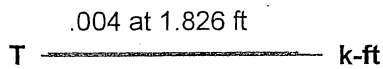
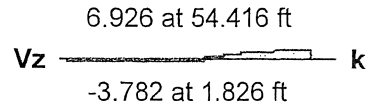
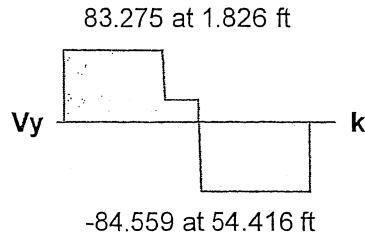
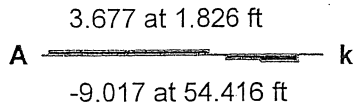
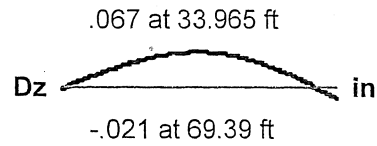
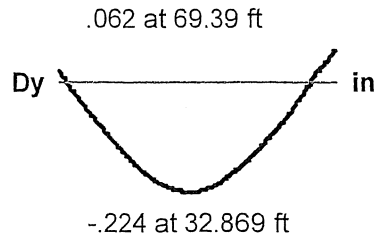
I Joint: **N1**

J Joint: **N4**

LC 20: Mom Std A

Code Check: **0.000 (bending)**

Report Based On 191 Sections



VCJM
initial
Sketch
recheck
6/2/10

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

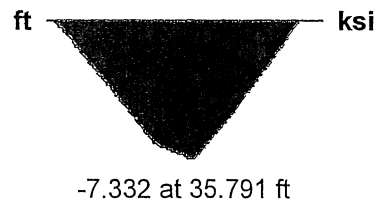
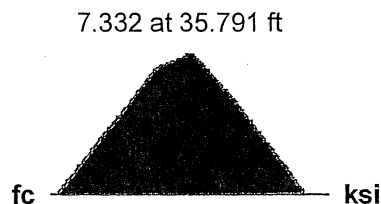
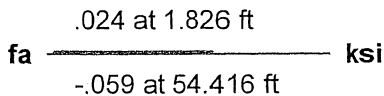
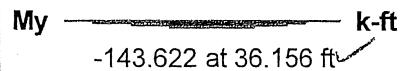
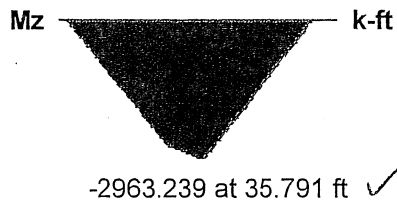
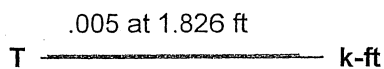
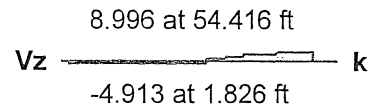
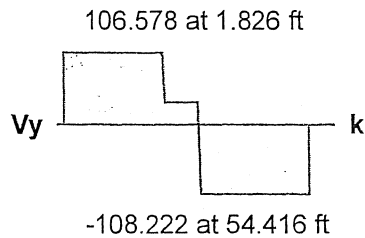
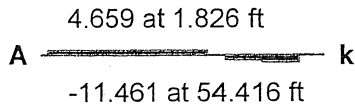
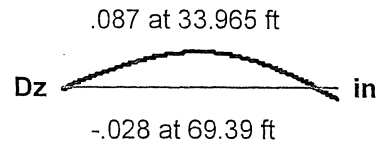
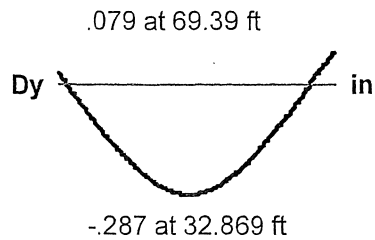
I Joint: **N1**

J Joint: **N4**

LC 21: Mom Std B

Code Check: **0.000 (bending)**

Report Based On 191 Sections



✓com
initial
5/10/10
recheck
calculation

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

I Joint: **N1**

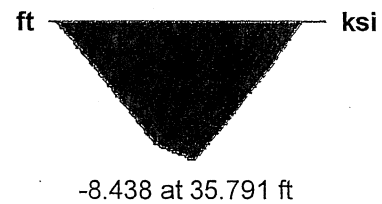
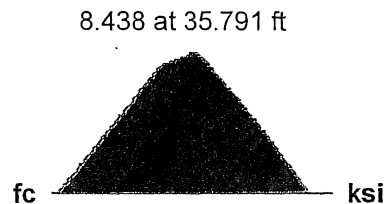
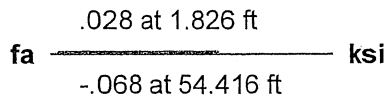
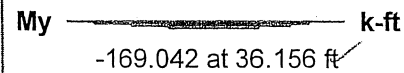
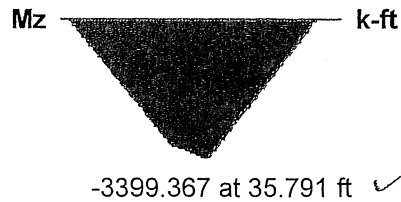
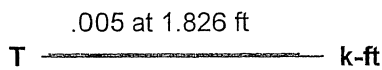
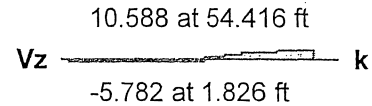
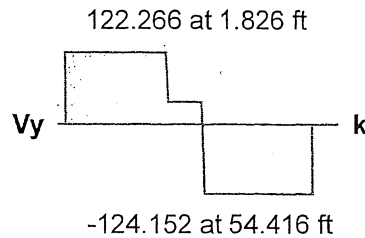
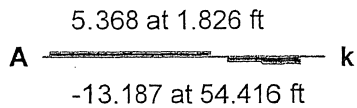
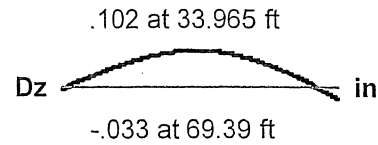
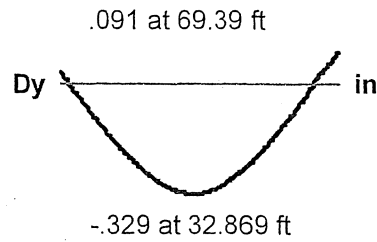
J Joint: **N4**

LC 22: Mom Std C

Code Check: **0.000 (bending)**

Report Based On 191 Sections

UCM
Initial
5/10/10
Recheck
6/24/10



Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

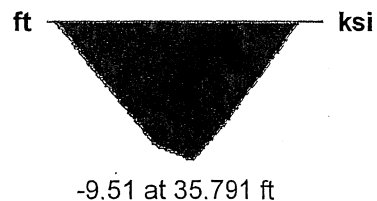
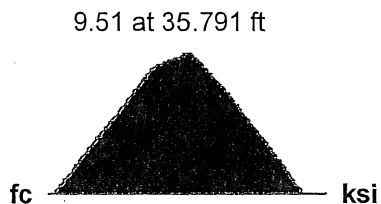
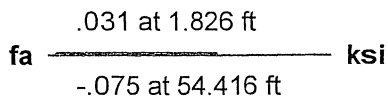
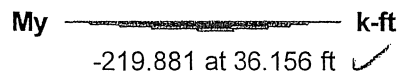
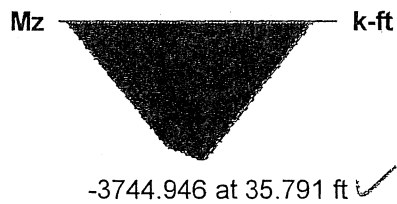
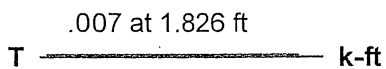
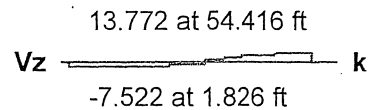
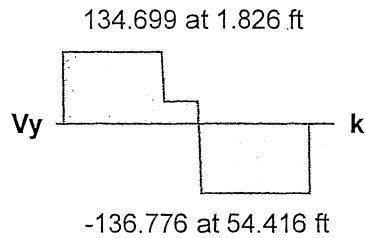
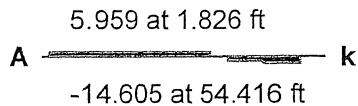
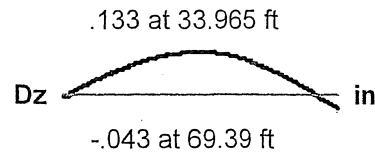
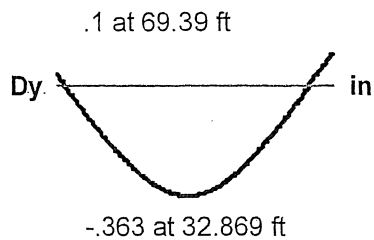
I Joint: **N1**

J Joint: **N4**

LC 23: Mom P411

Code Check: **0.000 (bending)**

Report Based On 191 Sections



LC23
initial
slope
recheck
0.000

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

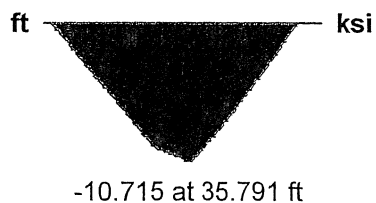
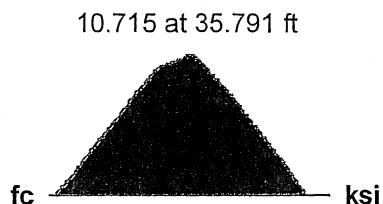
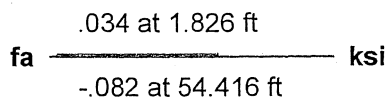
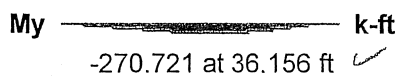
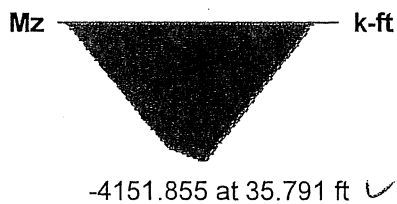
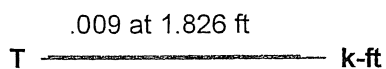
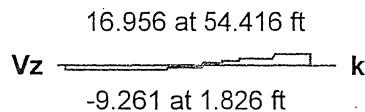
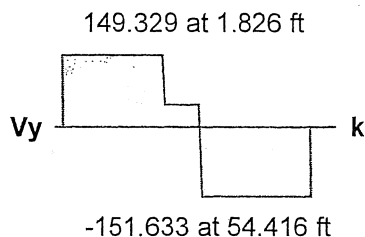
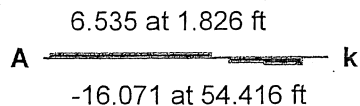
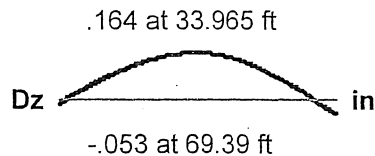
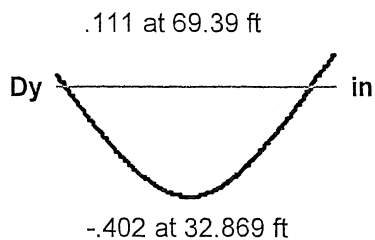
I Joint: **N1**

J Joint: **N4**

LC 24: Mom P413

Code Check: **0.000 (bending)**

Report Based On 191 Sections



✓ CJM
initial
5/10/10
recheck
6/24/10

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

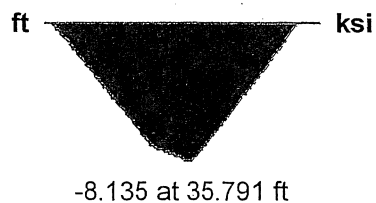
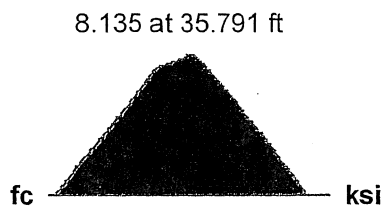
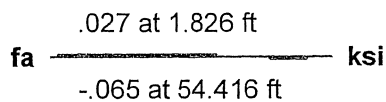
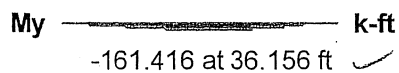
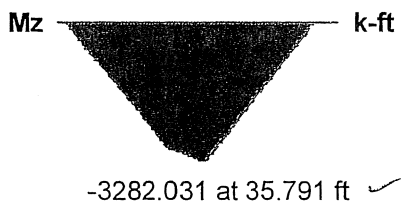
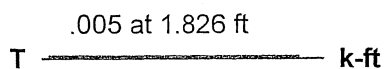
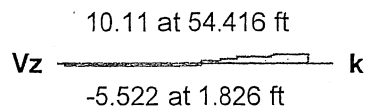
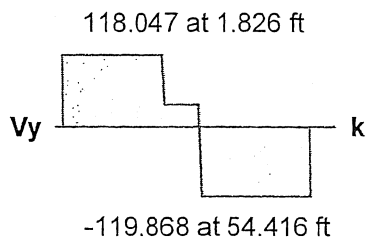
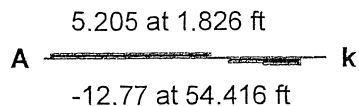
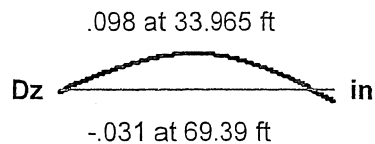
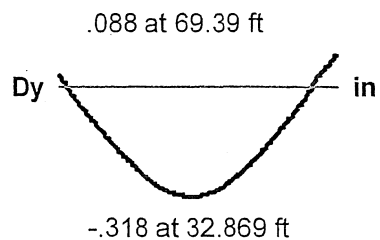
I Joint: **N1**

J Joint: **N4**

LC 25: Mom Std C152b

Code Check: **0.000 (bending)**

Report Based On 191 Sections



Vcm
initial
5/10/10
recheck
6/24/10

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

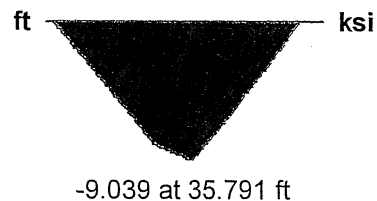
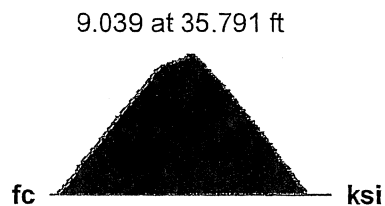
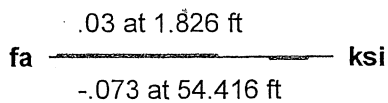
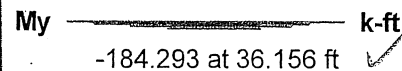
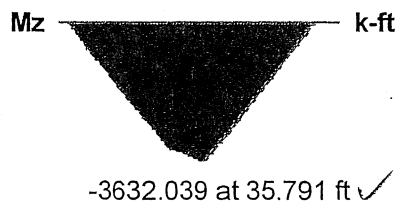
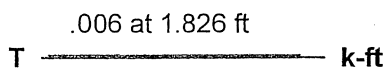
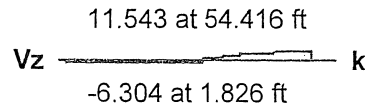
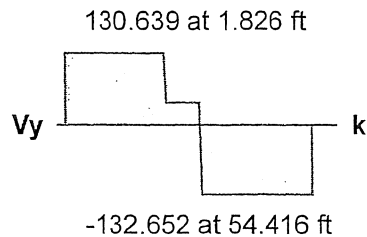
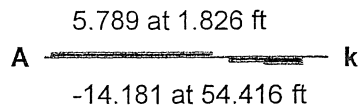
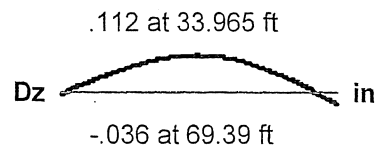
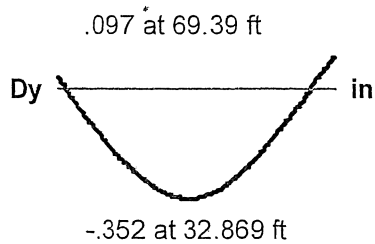
I Joint: **N1**

J Joint: **N4**

LC 26: Mom Std C174b

Code Check: **0.000 (bending)**

Report Based On 191 Sections



begin
initial
slope
recheck
blue

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

I Joint: **N1**

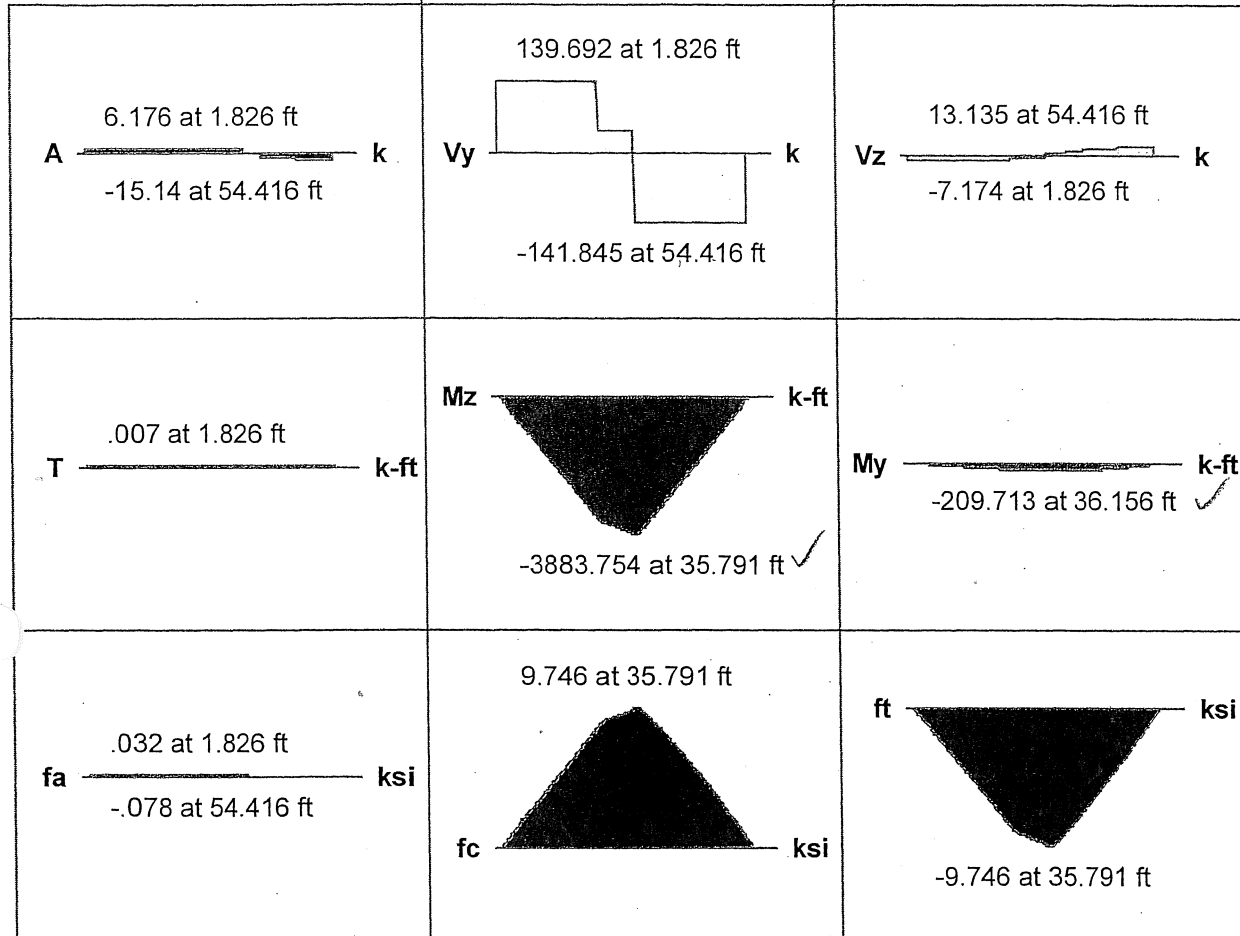
J Joint: **N4**

LC 27: Mom Std C198_23

Code Check: **0.000 (bending)**

Report Based On 191 Sections

UCM
initial
5/10/10
recheck
GZallo



Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

I Joint: **N1**

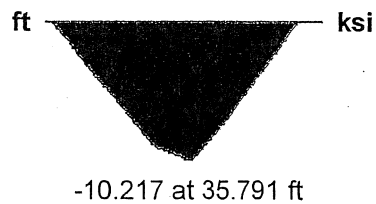
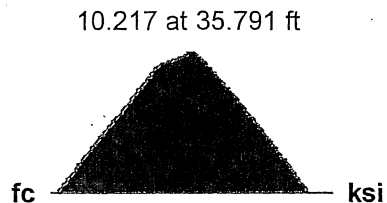
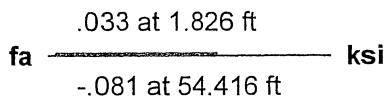
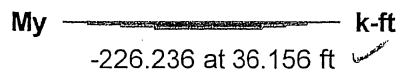
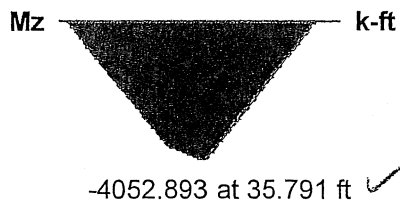
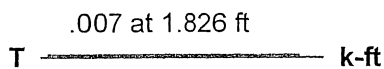
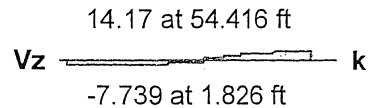
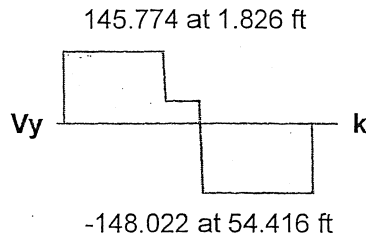
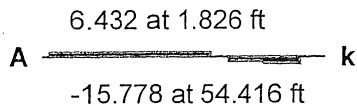
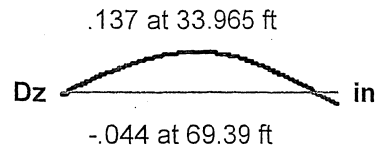
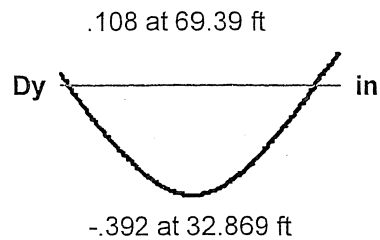
J Joint: **N4**

LC 28: Mom Std 214b

Code Check: **0.000 (bending)**

Report Based On 191 Sections

✓
initial
Sto/lo
✓
check
6/24/10



Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

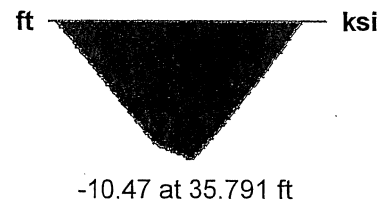
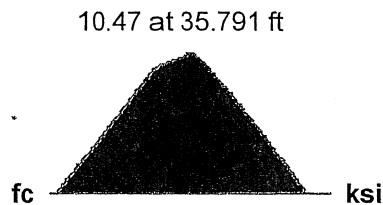
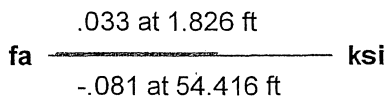
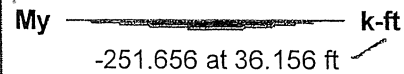
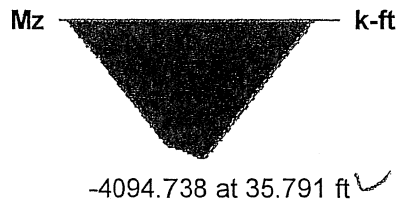
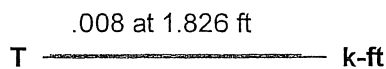
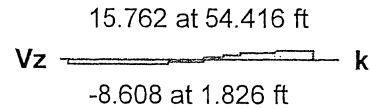
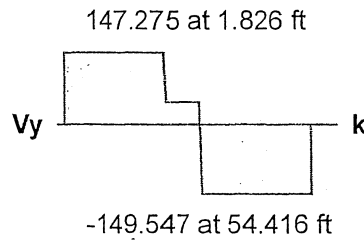
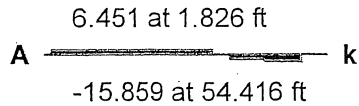
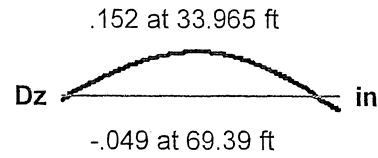
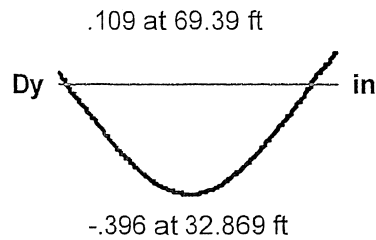
I Joint: **N1**

J Joint: **N4**

LC 29: Mom Std C237b

Code Check: **0.000 (bending)**

Report Based On 191 Sections



Verify
initial
slope
recheck
6/24/12

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

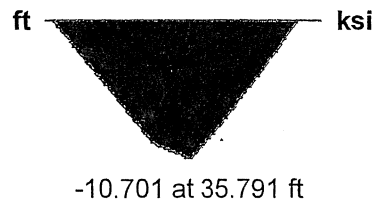
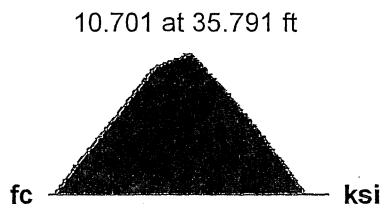
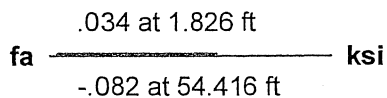
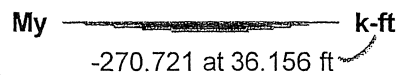
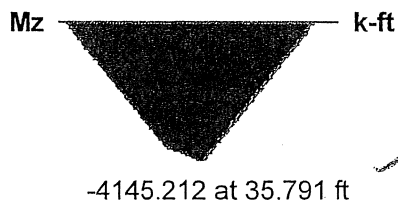
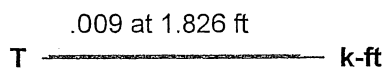
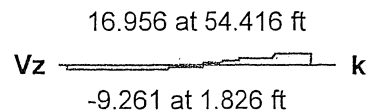
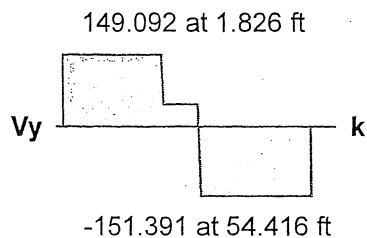
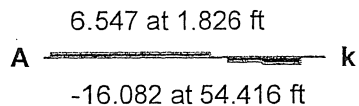
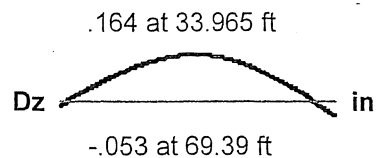
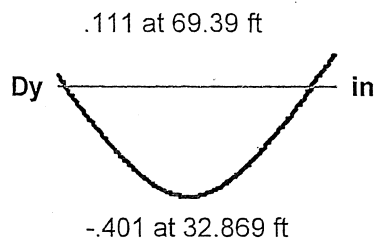
I Joint: **N1**

J Joint: **N4**

LC 30: Mom Std C256b

Code Check: **0.000 (bending)**

Report Based On 191 Sections



UJIM
initial
Sketch
recheck
UJIM

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **69.39 ft**

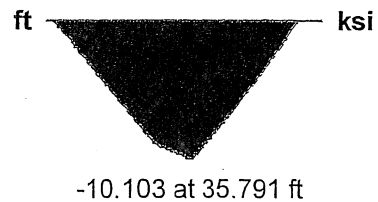
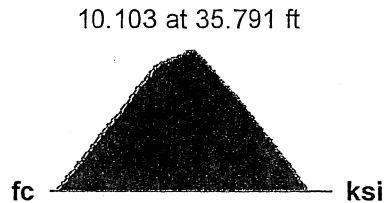
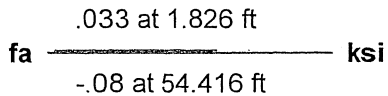
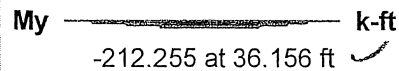
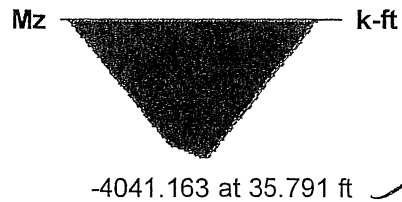
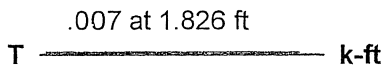
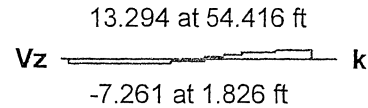
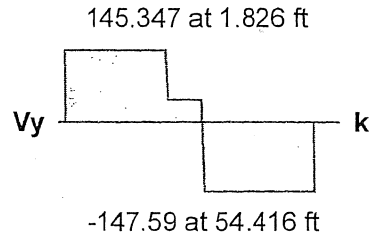
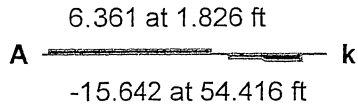
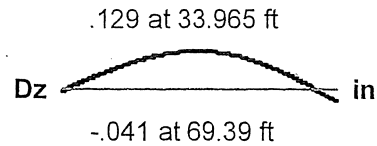
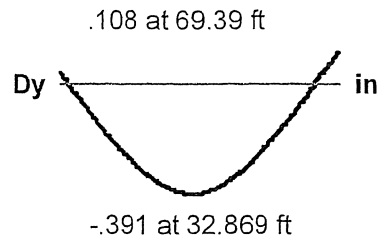
I Joint: **N1**

J Joint: **N4**

LC 31: Mom Std C200j

Code Check: **0.000 (bending)**

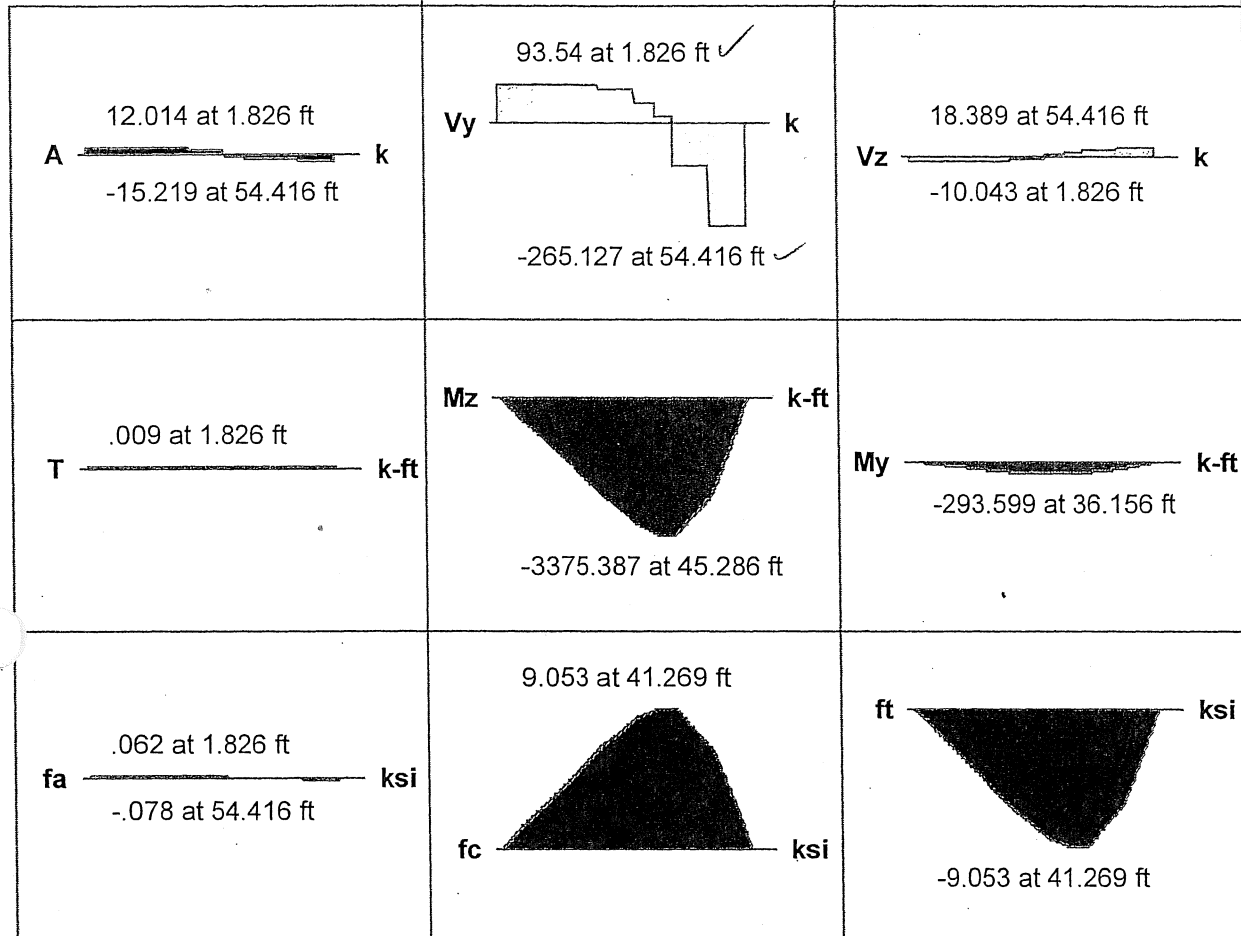
Report Based On 191 Sections



VCJM
initial
5/10/10
recheck
6/24/10

Beam: **M1**
 Shape: **BR3A-P6-1**
 Material: **A36 Steel**
 Length: **69.39 ft**
 I Joint: **N1**
 J Joint: **N4**
 LC 32: **Shr P413 + SU7**
 Code Check: **0.000 (bending)**
 Report Based On 191 Sections

VCTM
 initial
 5/10/10
 recheck
 GZUBO



MnDOT Special Structures, 69801J
Pier Cap P6-3A Reactions under posting and permit loads
19-Apr-10

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Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

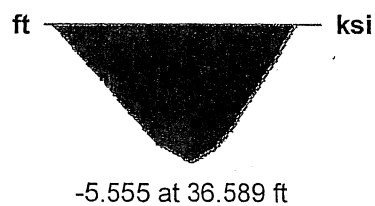
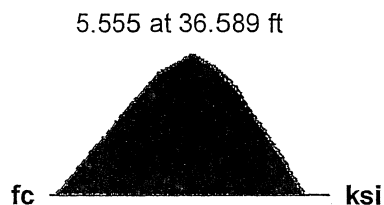
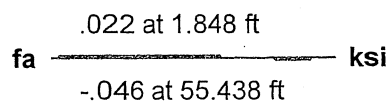
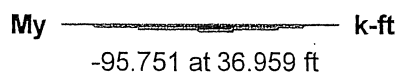
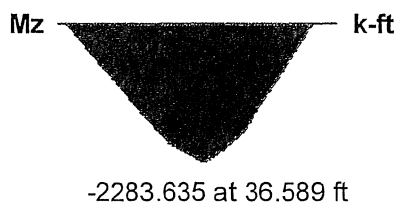
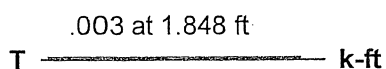
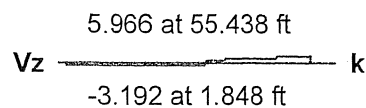
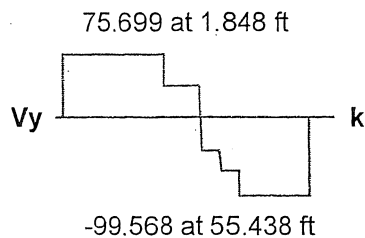
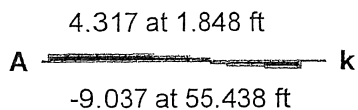
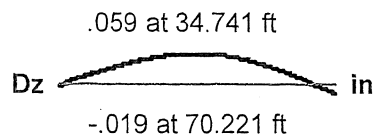
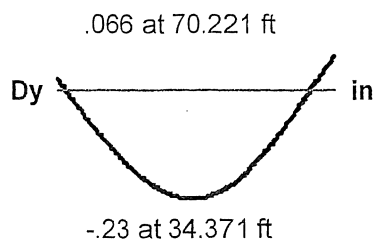
I Joint: **N1**

J Joint: **N4**

LC 5: Mom Type 3 + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



S 5/21/10

DD-56

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

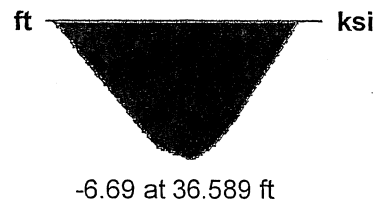
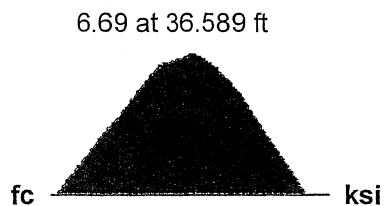
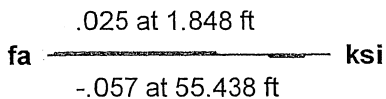
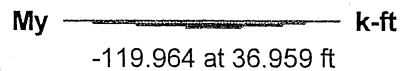
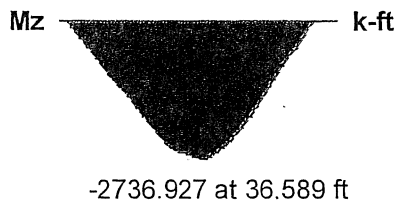
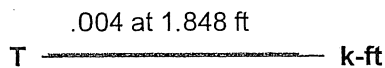
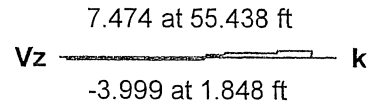
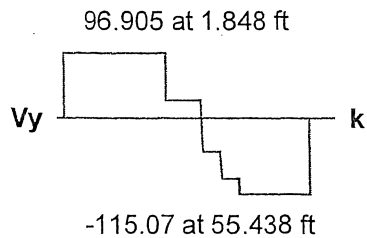
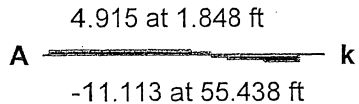
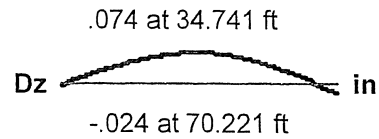
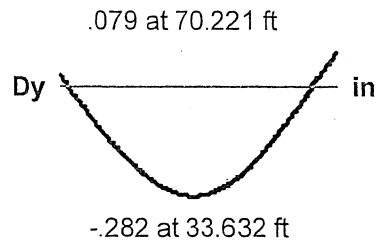
I Joint: **N1**

J Joint: **N4**

LC 6: Mom Type 3S2-40 + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



S 5/21/10

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

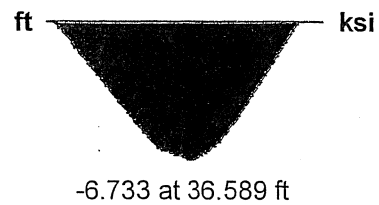
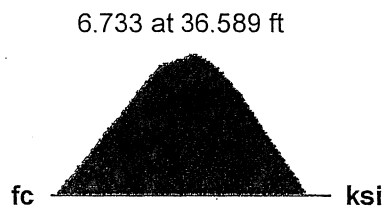
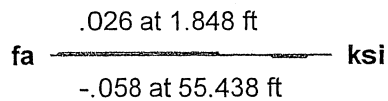
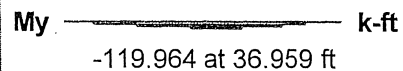
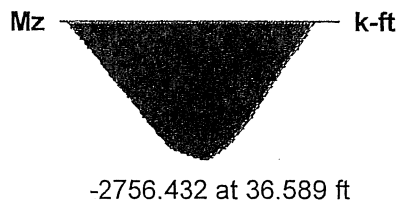
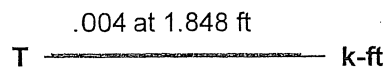
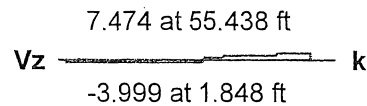
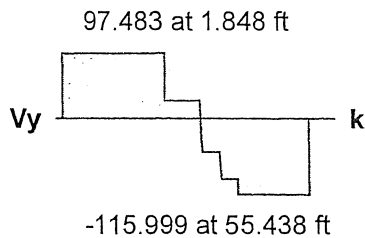
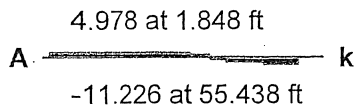
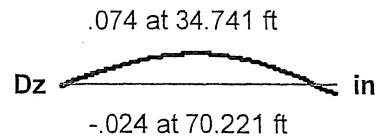
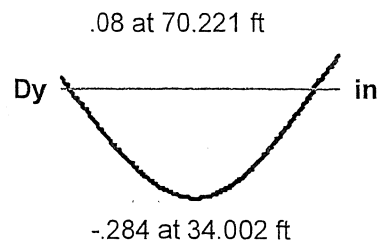
I Joint: **N1**

J Joint: **N4**

LC 7: Mom Type 3S3 +SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



S 5/21/10

DD-58

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

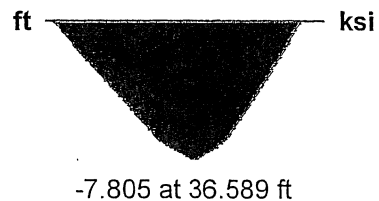
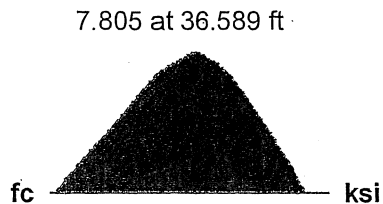
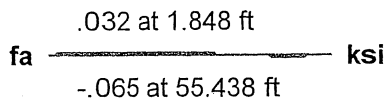
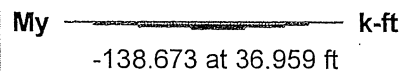
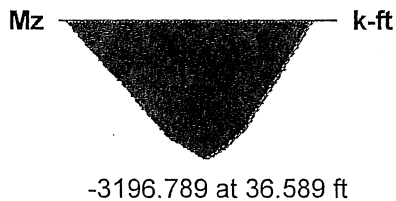
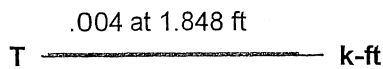
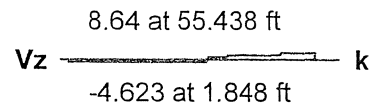
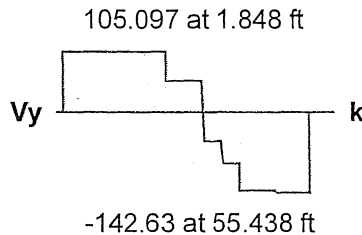
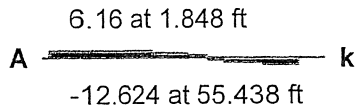
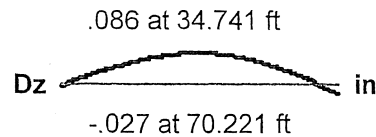
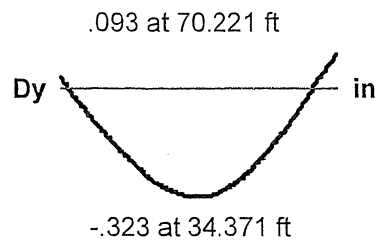
I Joint: **N1**

J Joint: **N4**

LC 8: Mom Std A + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



S 5/21/10

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

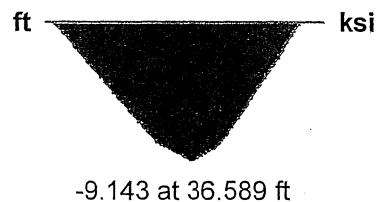
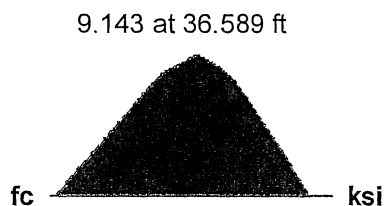
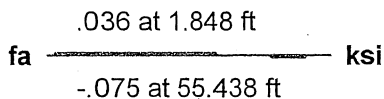
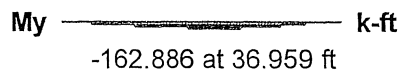
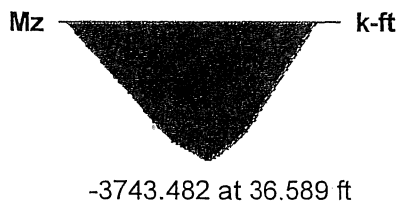
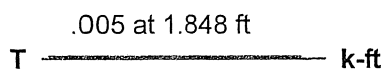
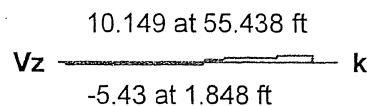
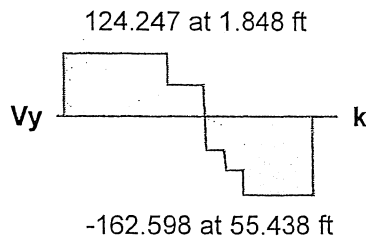
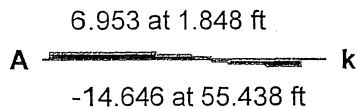
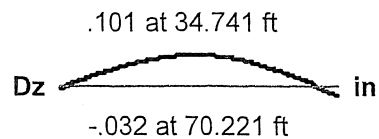
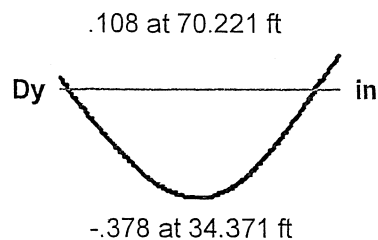
I Joint: **N1**

J Joint: **N4**

LC 9: **Mom Std B + SU7**

Code Check: **0.000 (bending)**

Report Based On 191 Sections



S 5/21/10

DD-60

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

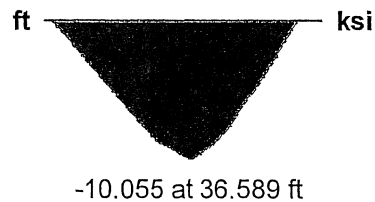
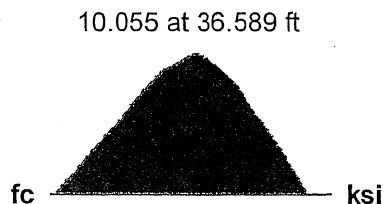
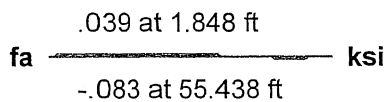
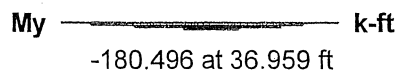
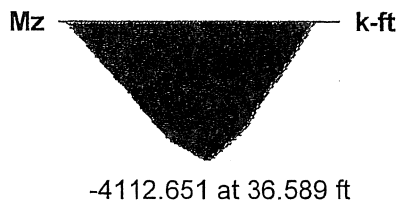
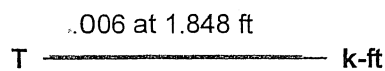
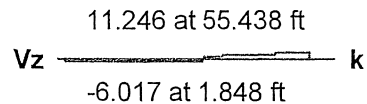
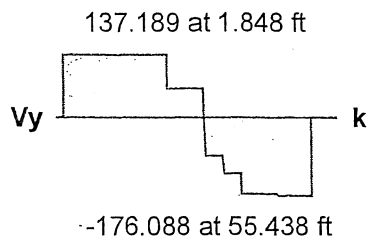
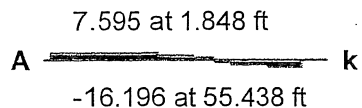
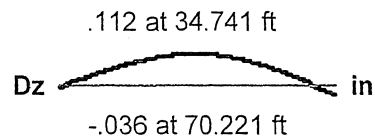
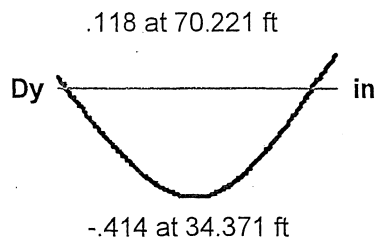
I Joint: **N1**

J Joint: **N4**

LC 10: Mom Std C +SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



S 5/21/10

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

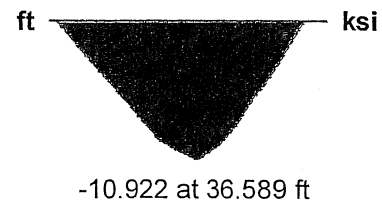
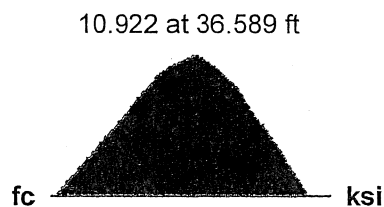
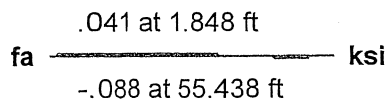
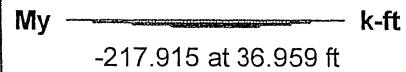
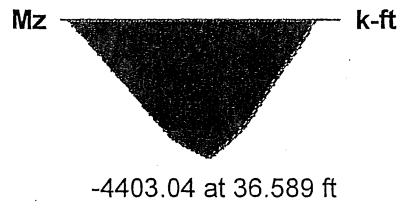
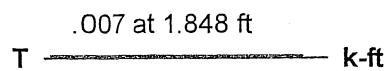
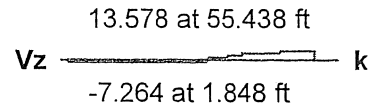
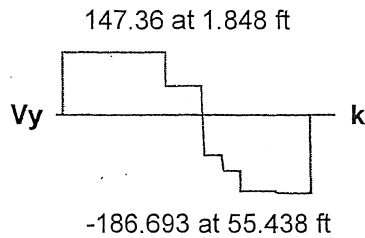
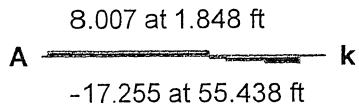
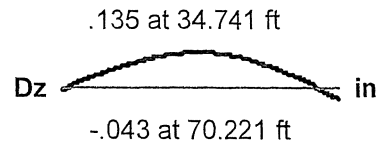
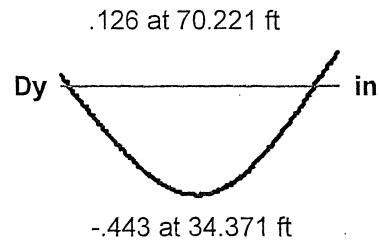
I Joint: **N1**

J Joint: **N4**

LC 11: Mom P411 + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



S 5/21/10

DD-607

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

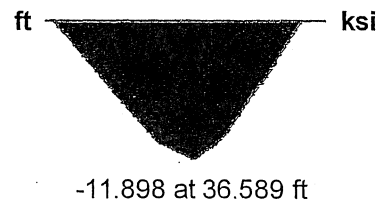
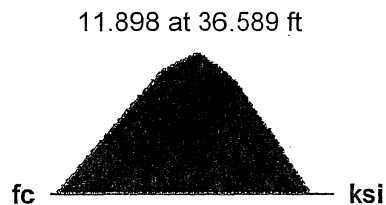
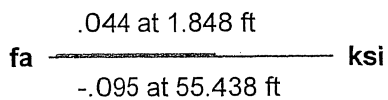
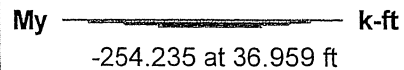
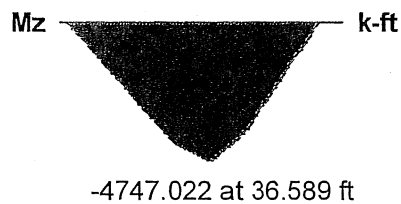
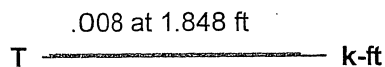
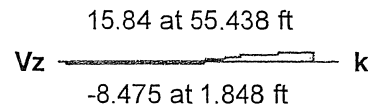
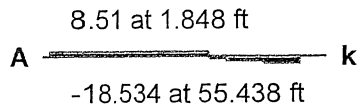
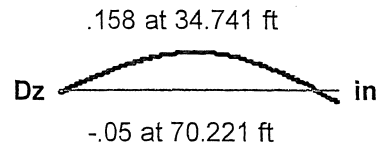
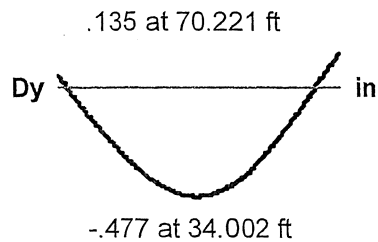
I Joint: **N1**

J Joint: **N4**

LC 12: Mom P413 + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



5/5/21/10

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

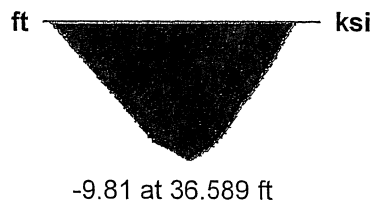
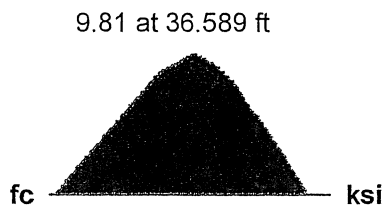
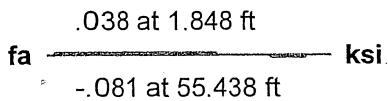
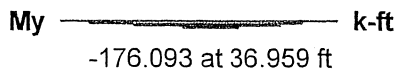
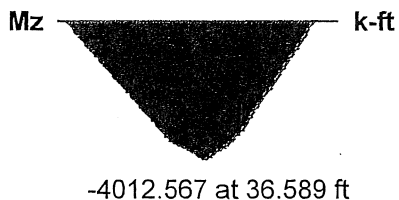
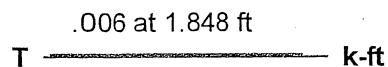
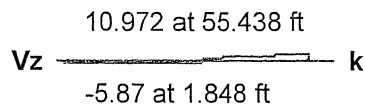
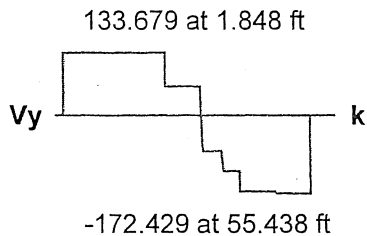
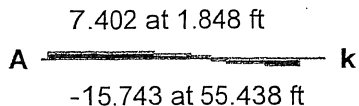
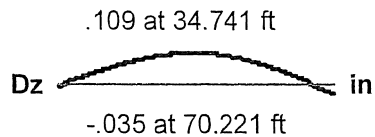
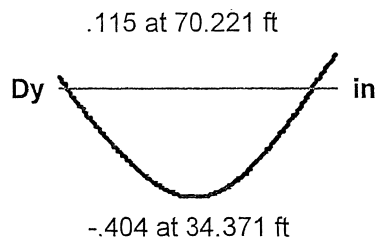
I Joint: **N1**

J Joint: **N4**

LC 13: Mom Std C152b + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



5/21/10

DD-64

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

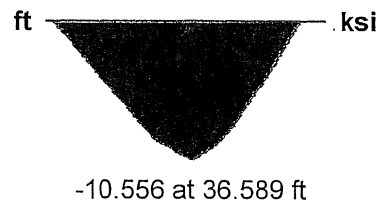
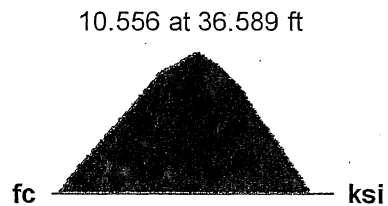
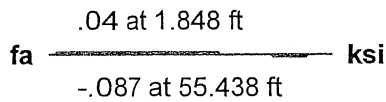
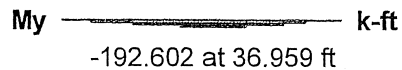
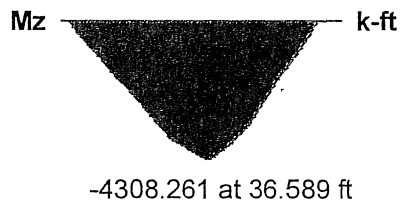
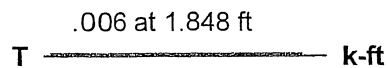
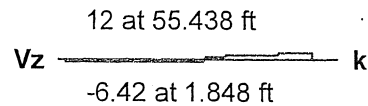
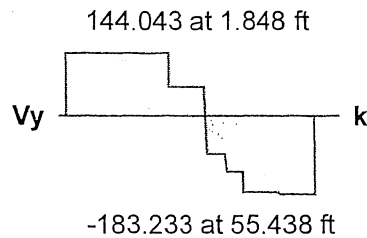
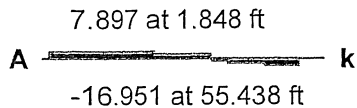
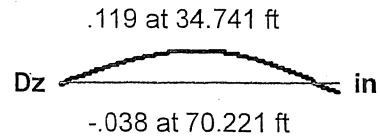
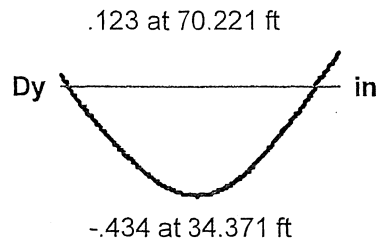
I Joint: **N1**

J Joint: **N4**

LC 14: Mom Std C174b + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



S 5/21/10

DD-65

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

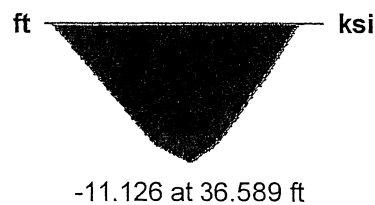
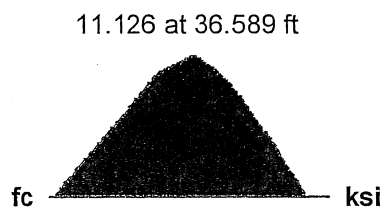
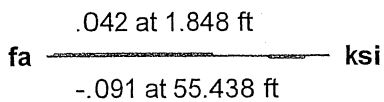
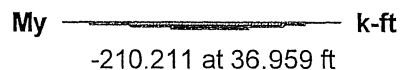
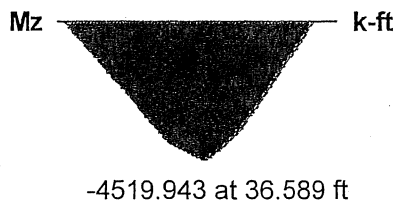
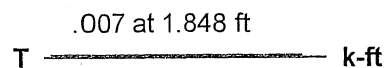
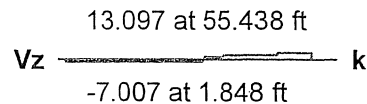
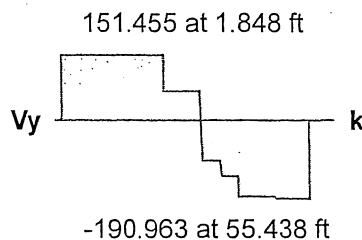
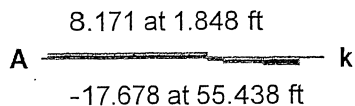
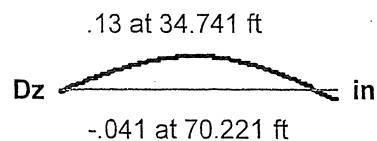
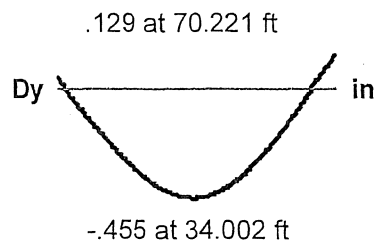
I Joint: **N1**

J Joint: **N4**

LC 15: Mom Std C198_23 + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



5/21/10

DD-666

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

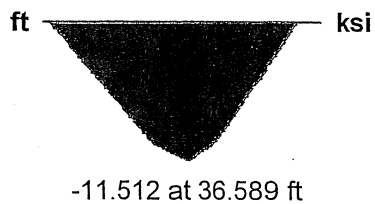
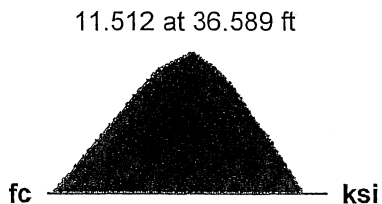
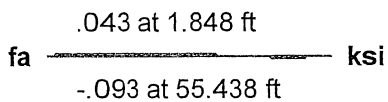
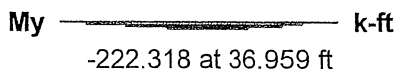
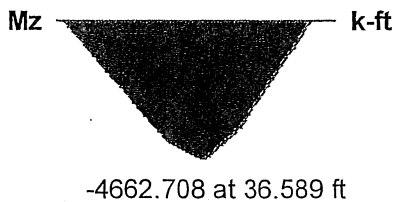
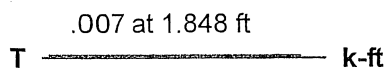
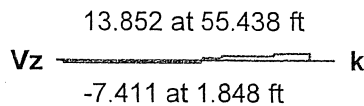
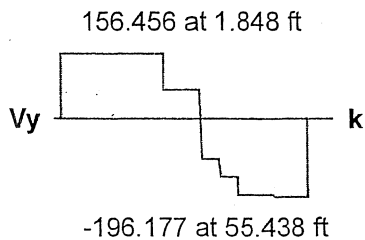
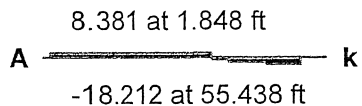
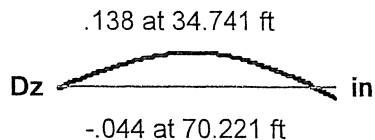
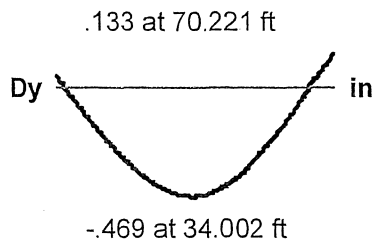
I Joint: **N1**

J Joint: **N4**

LC 16: Mom Std 214b + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



5/21/10

DD-67

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

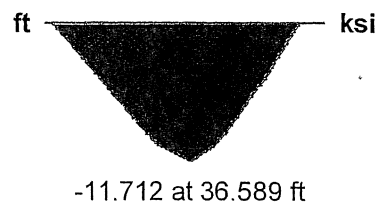
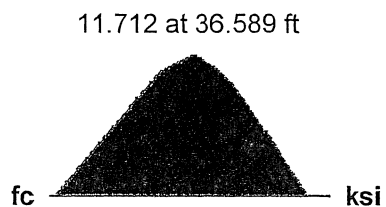
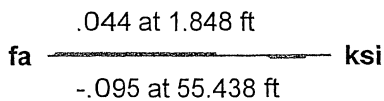
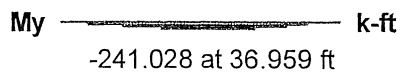
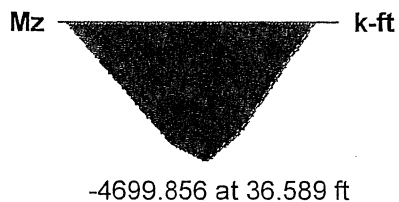
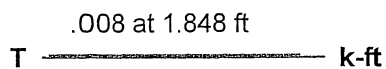
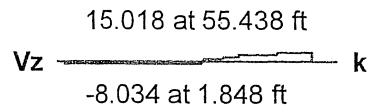
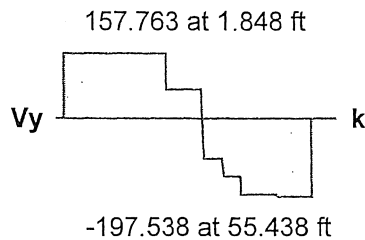
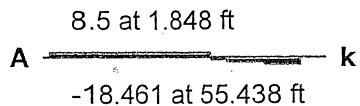
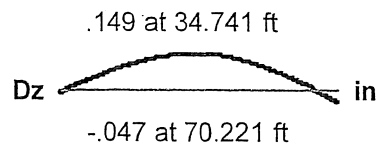
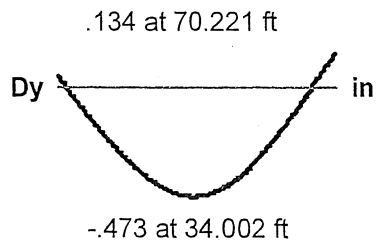
I Joint: **N1**

J Joint: **N4**

LC 17: Mom Std C237b + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



5/21/10

DD-68

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

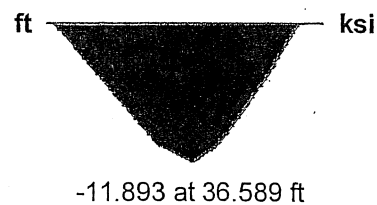
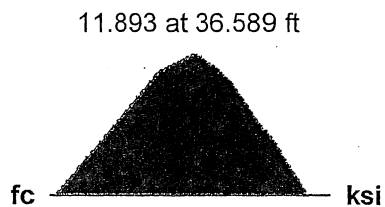
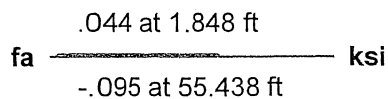
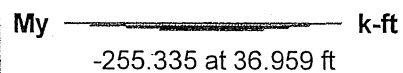
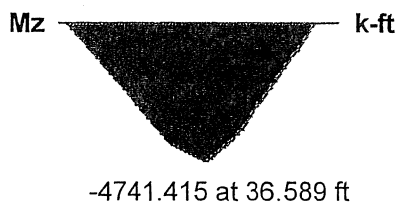
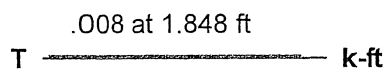
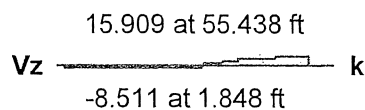
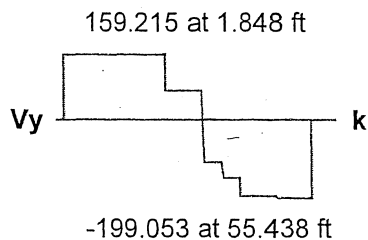
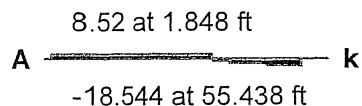
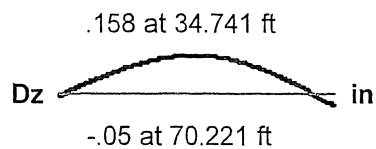
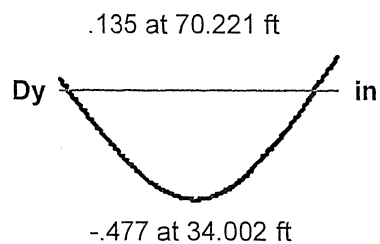
I Joint: **N1**

J Joint: **N4**

LC 18: Mom Std C256b + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



S 5/21/10

DD-69

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

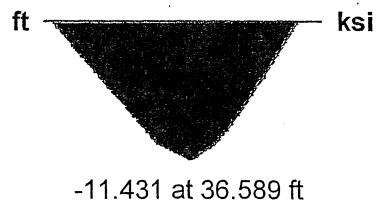
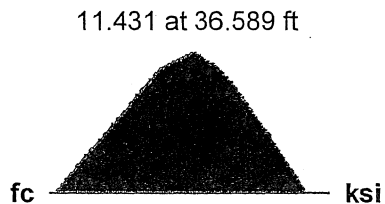
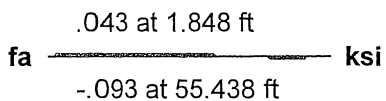
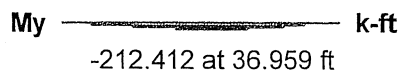
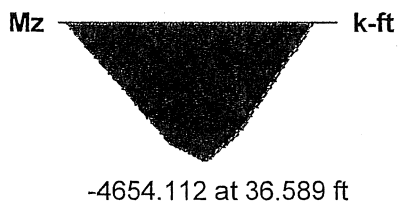
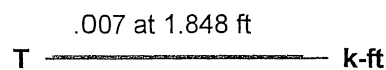
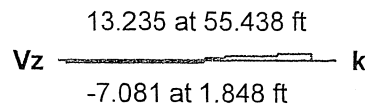
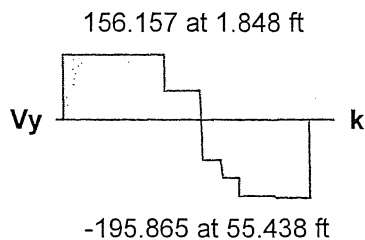
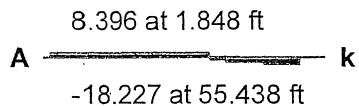
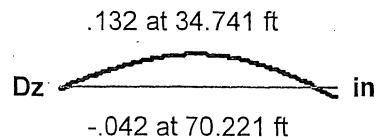
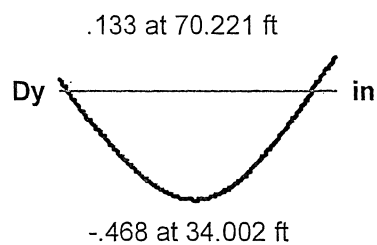
I Joint: **N1**

J Joint: **N4**

LC 19: Mom Std C200j + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



S 5/21/10

DD-70

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

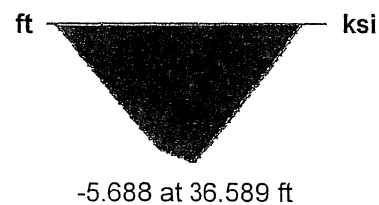
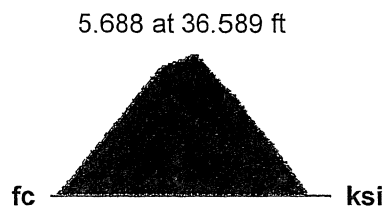
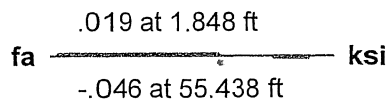
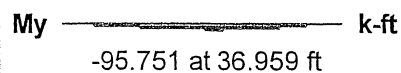
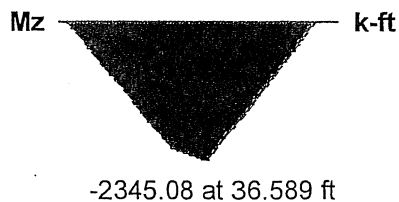
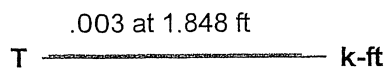
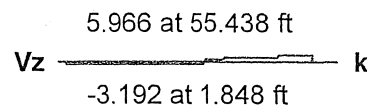
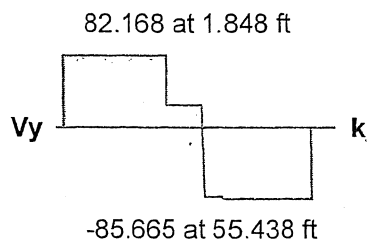
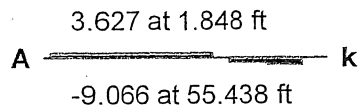
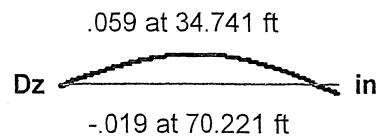
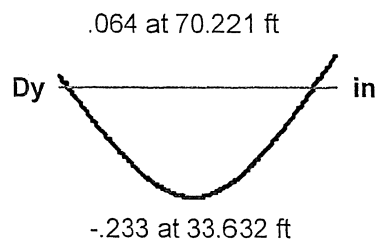
I Joint: **N1**

J Joint: **N4**

LC 20: Mom Std A

Code Check: **0.000 (bending)**

Report Based On 191 Sections



5/21/10

DD-71

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

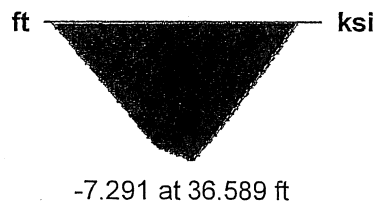
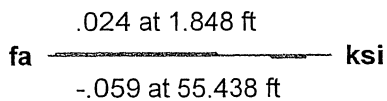
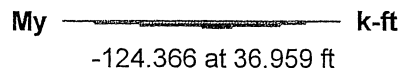
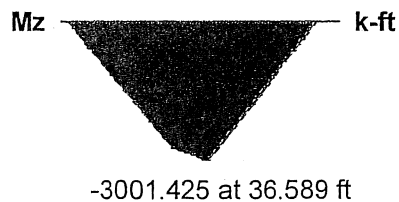
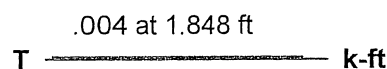
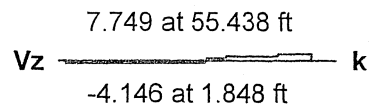
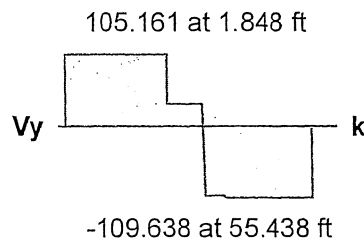
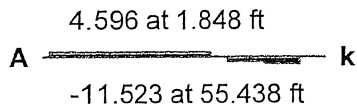
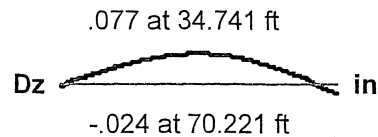
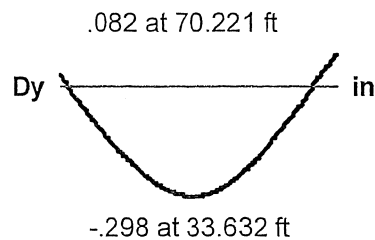
I Joint: **N1**

J Joint: **N4**

LC 21: Mom Std B

Code Check: **0.000 (bending)**

Report Based On 191 Sections



5/21/10

DD-72

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

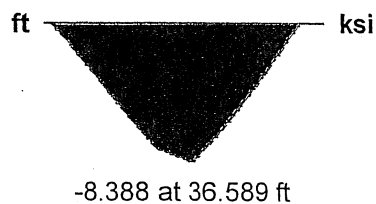
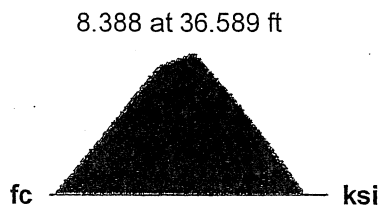
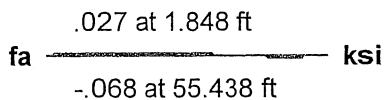
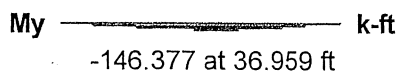
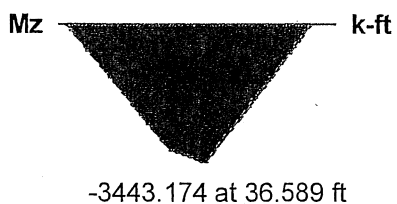
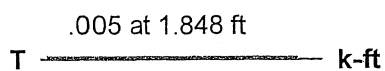
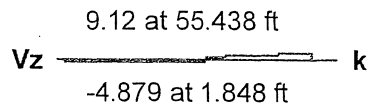
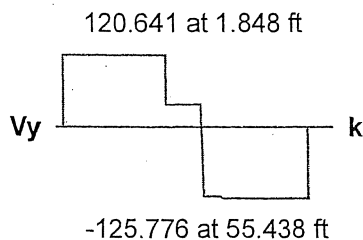
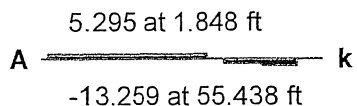
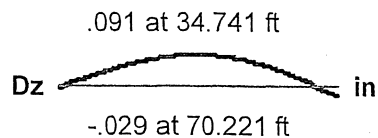
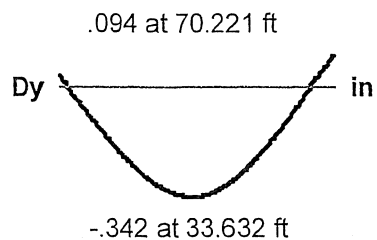
I Joint: **N1**

J Joint: **N4**

LC 22: Mom Std C

Code Check: **0.000 (bending)**

Report Based On 191 Sections



5/5/21/10

DD-73

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

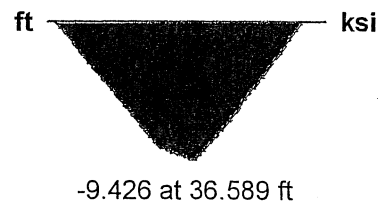
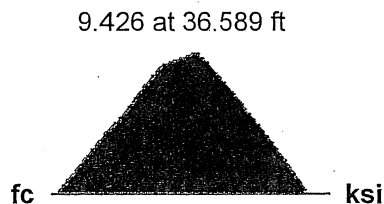
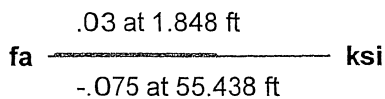
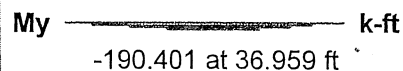
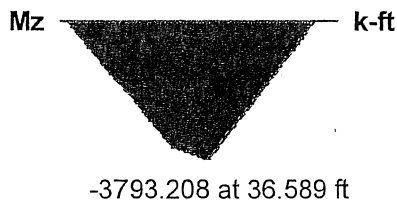
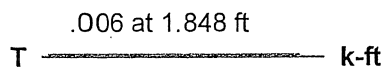
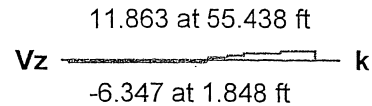
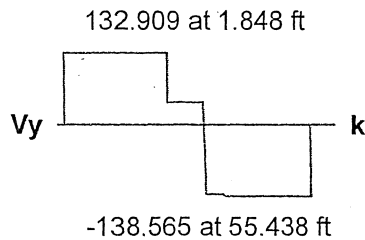
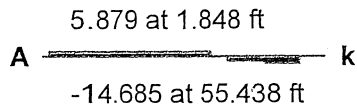
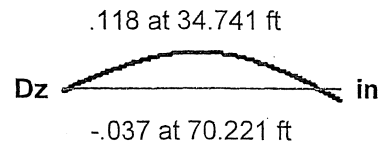
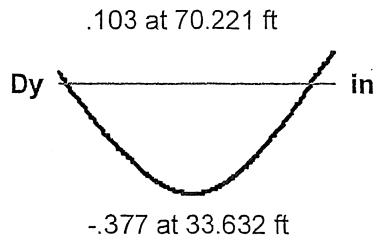
I Joint: **N1**

J Joint: **N4**

LC 23: Mom P411

Code Check: **0.000 (bending)**

Report Based On 191 Sections



6/5/2010

DD-74

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

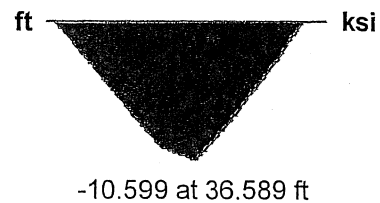
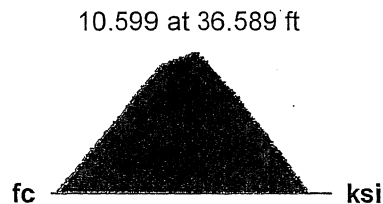
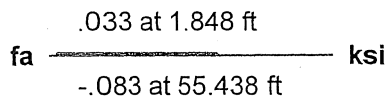
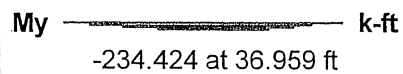
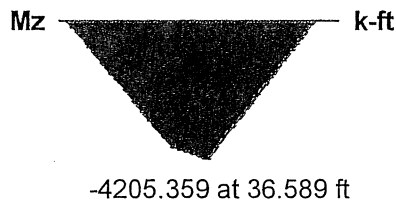
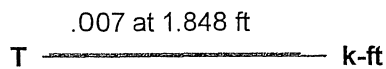
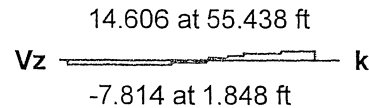
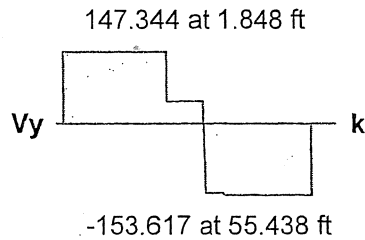
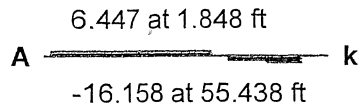
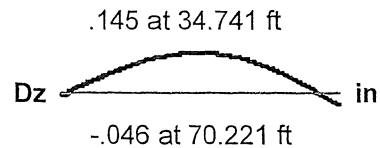
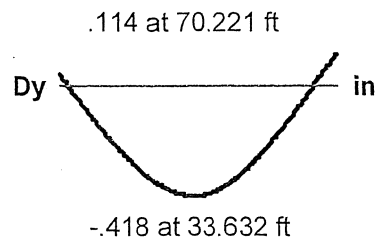
I Joint: **N1**

J Joint: **N4**

LC 24: Mom P413

Code Check: **0.000 (bending)**

Report Based On 191 Sections



6/5/12/10

DD-75

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

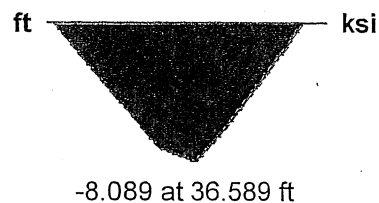
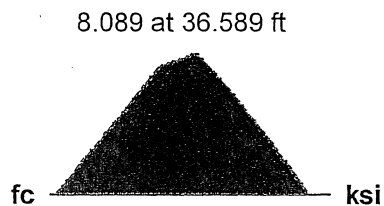
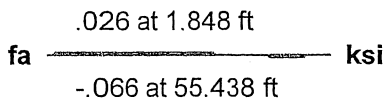
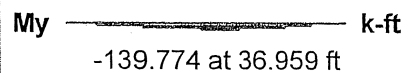
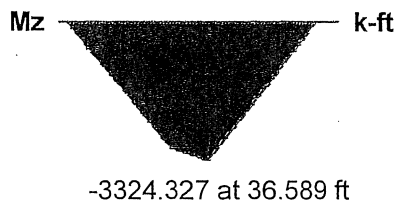
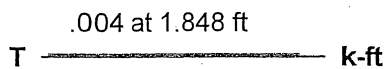
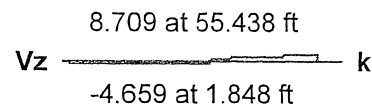
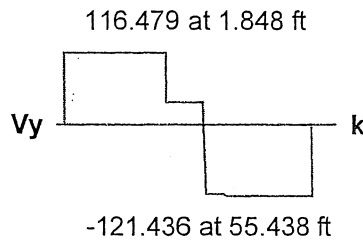
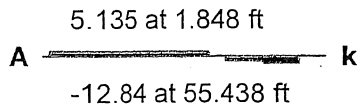
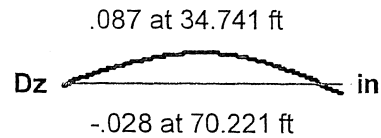
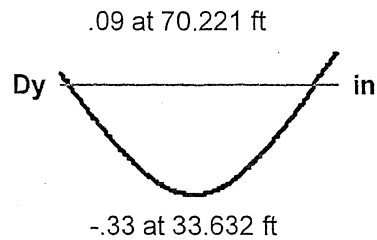
I Joint: **N1**

J Joint: **N4**

LC 25: Mom Std C152b

Code Check: **0.000 (bending)**

Report Based On 191 Sections



5/21/10

DD-76

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

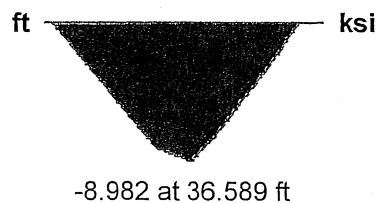
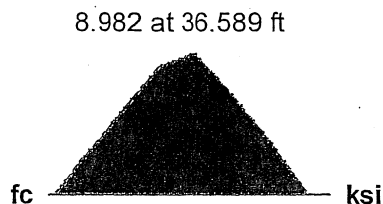
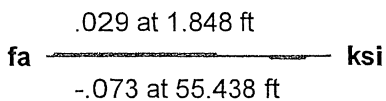
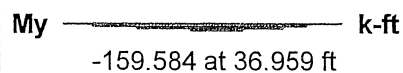
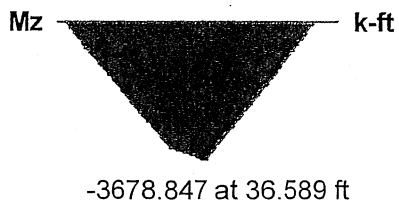
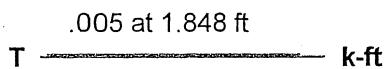
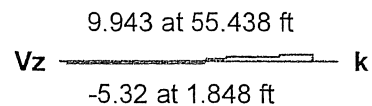
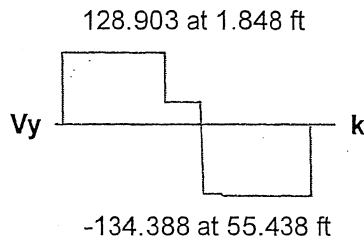
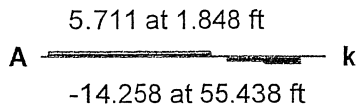
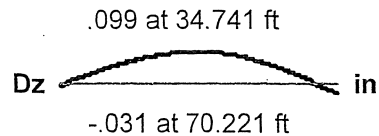
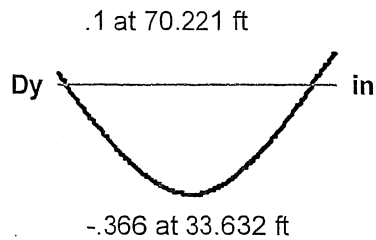
I Joint: **N1**

J Joint: **N4**

LC 26: Mom Std C174b

Code Check: **0.000 (bending)**

Report Based On 191 Sections



S5/21/10

DD-77

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

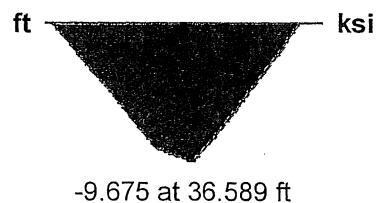
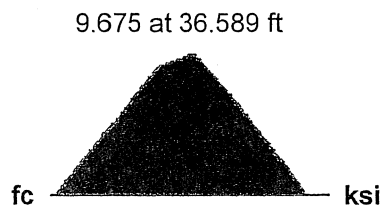
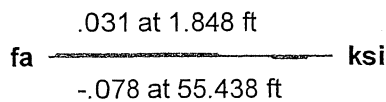
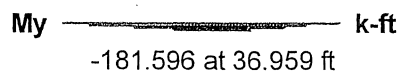
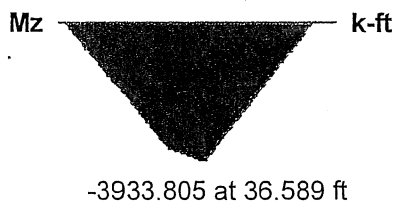
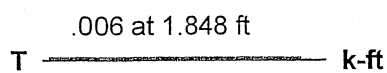
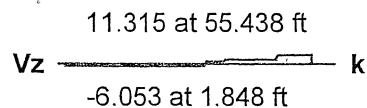
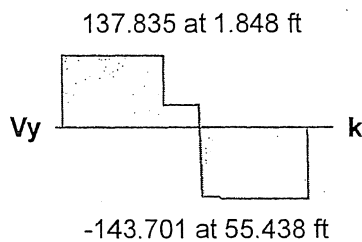
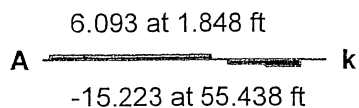
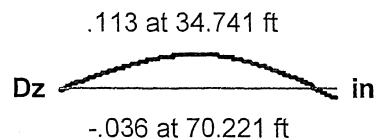
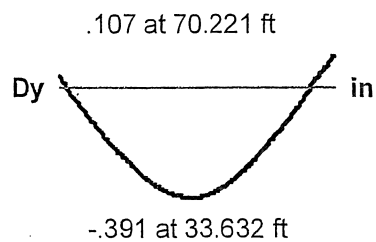
I Joint: **N1**

J Joint: **N4**

LC 27: Mom Std C198_23

Code Check: **0.000 (bending)**

Report Based On 191 Sections



S 5/2/10

DD-78

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

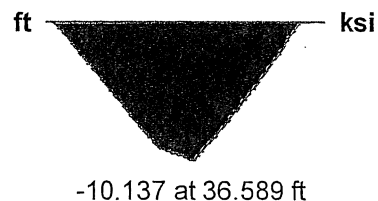
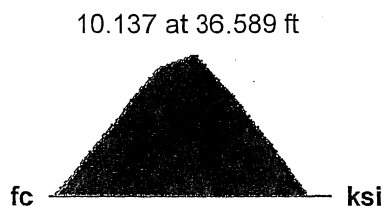
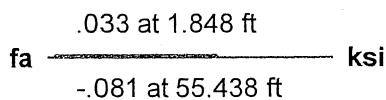
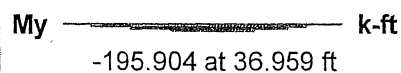
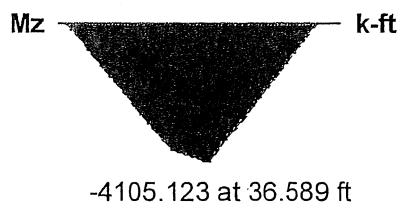
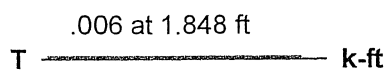
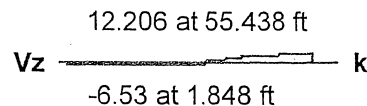
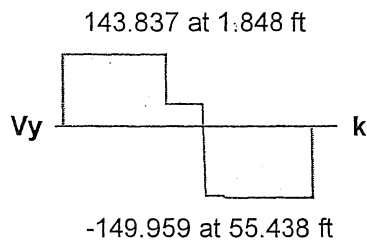
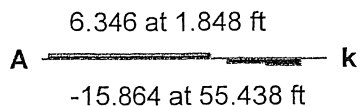
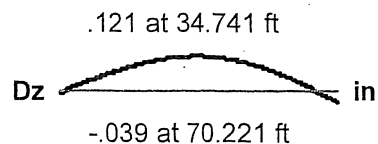
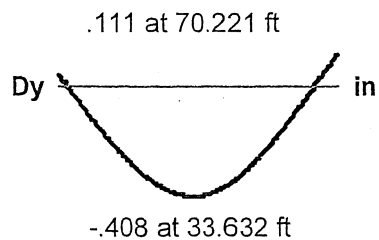
I Joint: **N1**

J Joint: **N4**

LC 28: Mom Std 214b

Code Check: **0.000 (bending)**

Report Based On 191 Sections



S 5/21/10

DD-79

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

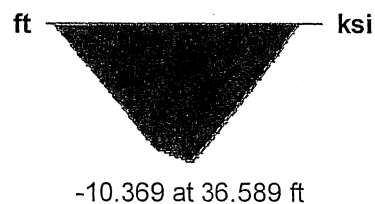
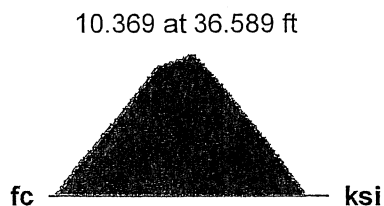
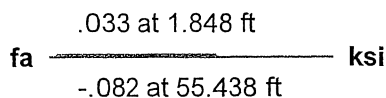
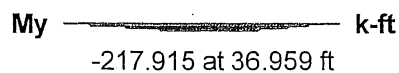
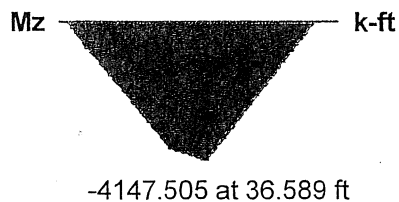
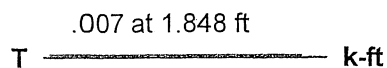
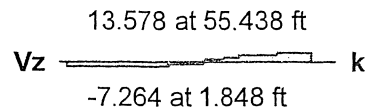
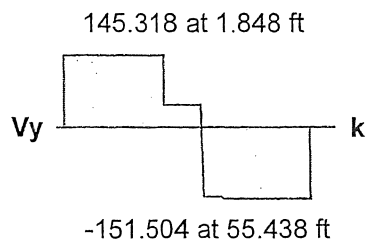
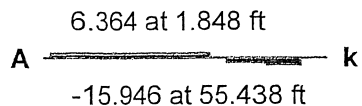
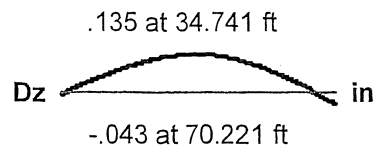
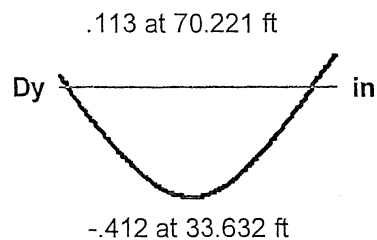
I Joint: **N1**

J Joint: **N4**

LC 29: Mom Std C237b

Code Check: **0.000 (bending)**

Report Based On 191 Sections



S 5/21/10

DD-80

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

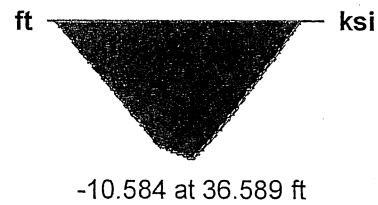
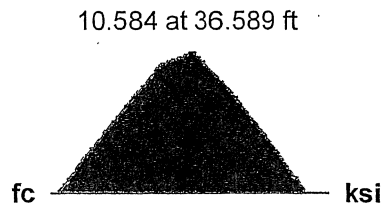
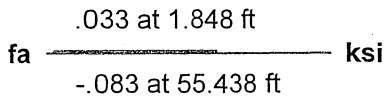
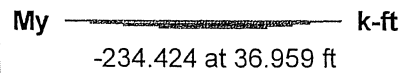
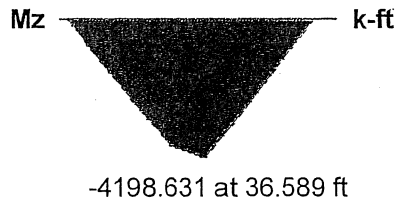
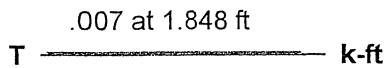
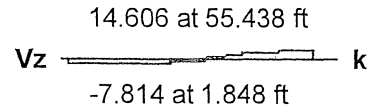
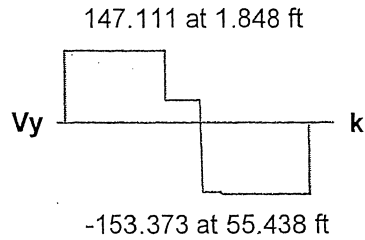
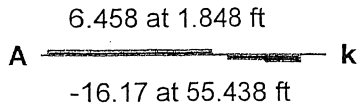
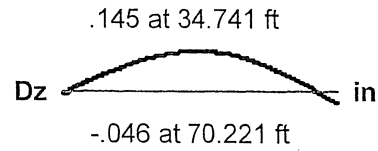
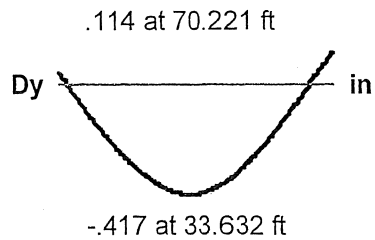
I Joint: **N1**

J Joint: **N4**

LC 30: Mom Std C256b

Code Check: **0.000 (bending)**

Report Based On 191 Sections



5/21/10

DD-81

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

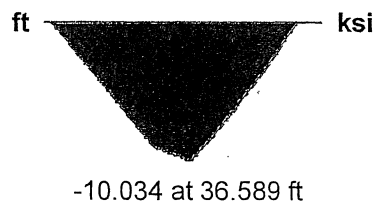
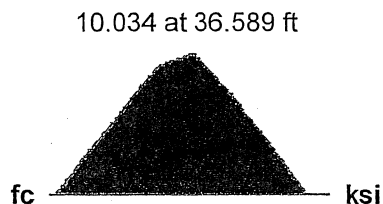
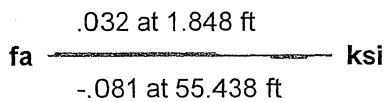
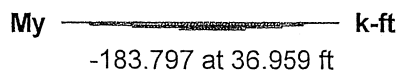
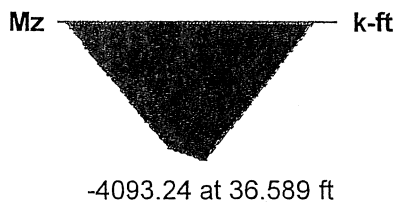
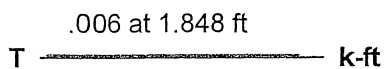
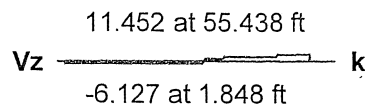
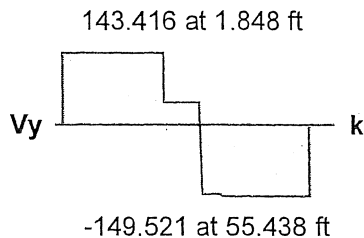
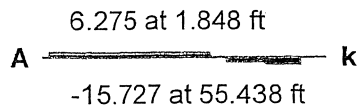
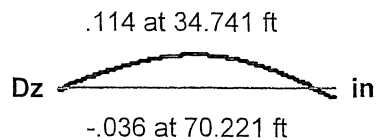
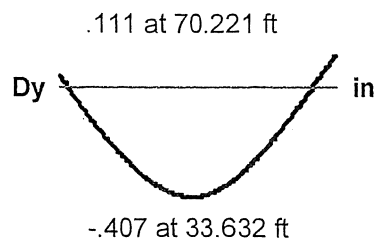
I Joint: **N1**

J Joint: **N4**

LC 31: Mom Std C200j

Code Check: **0.000 (bending)**

Report Based On 191 Sections



S 5/21/10

DD-82

Beam: **M1**

Shape: **BR3A-P6-1**

Material: **A36 Steel**

Length: **70.221 ft**

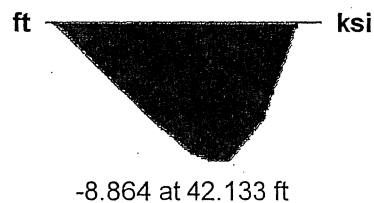
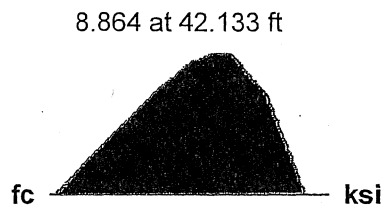
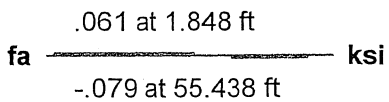
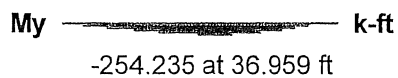
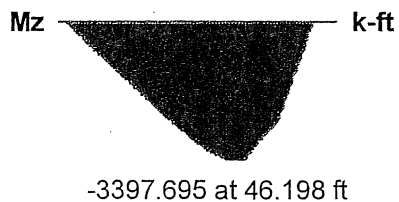
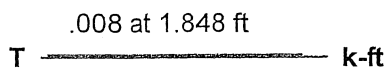
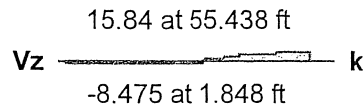
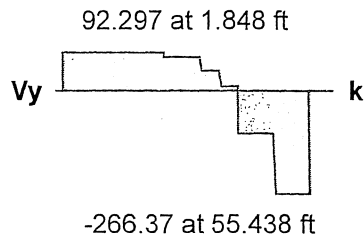
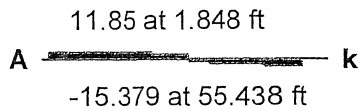
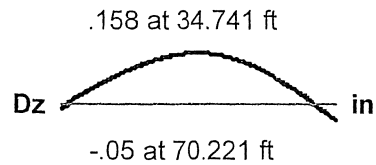
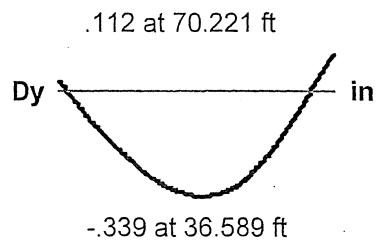
I Joint: **N1**

J Joint: **N4**

LC 32: Shr P413 + SU7

Code Check: **0.000 (bending)**

Report Based On 191 Sections



5/21/10

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PROJECT MnDOT SS-69801J-P6-3A - Posting/Permit Shear

PROJECT # 090147 DATE 4/15/10 BY jdF SHEET NO. _____ OF _____

5/10/10

Evaluate the Pier cap for Shear with P413 + SU7 trucks w/ multiple trip factors. (P413 had the highest wheel reaction)

$$V_{LL+Im \text{ south}} = \frac{265.1}{266.4} \text{ kip} \quad \text{See Shear P413 + SU7}$$

$$V_{LL+Im \text{ north}} \text{ will not control}$$

$$V_{DL \text{ south}} = \frac{372.0}{379.9} \text{ kip}$$

$$R_n = 1297 \text{ kip}$$

$$RF = \frac{1.0^3 \times 1297 - 1.25 \times \frac{372.0}{379.9}}{1.35 \times \frac{265.1}{266.4}} = \frac{2.30}{2.32}$$

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PROJECT Mn DOT SS-69801J-P6-3A - Posting / Permit Stiffeners
PROJECT # 090147 DATE 4/15/10 BY jd SHEET NO. 5/10/10 OF 5/10/10

Refer to the typical transverse stiffener check
and evaluate w/ Permit V_u 's.

$$V_u = 1.25 \times 372.0 + 1.75 \times 265.1 = 928.9$$

$$V_u > \phi V_{cr}$$

$$I_t \geq 21.4 + (41.79 - 21.4) \left(\frac{928.9 - 1.0 \times 423.1}{1.0 \times 1533.6 - 1.0 \times 423.1} \right)$$

$$\geq 21.4 + 20.39 \times (0.4608) = 30.69$$

$$I_t = 27 \text{ in}^4 \therefore \text{No Good.}$$