Appendix H

Specimen TCBF-B-1 to TCBF-B-4 Design Calculation Sheets

Title	TC	CBF-B-1 S	pecimen D	Design Calcu	ulation Sł	neet	Date August 16, 2008
General							Page 1
Typical floo F _{1, max} = F _{2, max} =	300 600	2 9 kip kip	stories ft			—F2·	$ \begin{array}{c} \bullet \\ d \\ \hline \\ a \\ \end{array} \begin{array}{c} \bullet \\ b \\ \hline \\ c \\ \end{array} \begin{array}{c} \bullet \\ \hline \\ b \\ \hline \\ c \\ \end{array} \begin{array}{c} \bullet \\ \hline \\ \hline \\ \\ \bullet \\ \end{array} \begin{array}{c} \bullet \\ \hline \\ \hline \\ \\ \hline \\ \\ \end{array} \begin{array}{c} \bullet \\ \hline \\ \\ \hline \\ \\ \\ \end{array} \begin{array}{c} \bullet \\ \\ \hline \\ \\ \\ \\ \end{array} \begin{array}{c} \bullet \\ \\ \\ \\ \\ \\ \\ \end{array} \begin{array}{c} \bullet \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \end{array} \begin{array}{c} \bullet \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $
SR = ratio =	4 0.8	-					← Span →
1410 -	0.0	_	C	Calculation I	nitialize		
Items	values	units		Items	values	units	
$F_1 =$	240	kip		$V_1 =$	720	kip	
$F_2 =$	480	kip		$V_2 =$		kip	
$h_1 =$	9	ft		2		F	
$h_2 =$	18	ft					
span =	20	ft	(beam spa	an)			
h =	9	ft	-	loor height)			
M _{base} =	13500	kip-ft					
$P_{column} =$	675	kip					
$L_{brace} =$	13.45	ft	(work poi	int to work j	point)		
$E_s =$	29000	ksi					
28	27000	KOI				Notes	
							: input value
				Materia	als		
Members	Materia		Fy (ksi)	Fu (ksi)	Ry	Rt	(Ref: Table I-6-1)
Columns	ASTM		50	65	1.1	1.1	_
Beams	ASTM		50	65	1.1	1.1	
Braces	ASTM		46	58	1.4	1.3	(HSS-Square)
Plates 1 Bolts	ASTN A4		36 130	58 150	1.3	1.2	-
Welds	E70		150	70		-	-
Plates 2	ASTM AS		50	65	1.1	1.2	1
				Load Combi			1
Per ASCE-7	-2005						
				sic Referen			
AISC Specif							
AISC Seism	ic Provisior	ns for Struc	ctural Steel	l Buildings	(March 9	, 2005)	

Title	TCBF	-B-1 Spec	cimen Design Calculatior	h Sheet	Date	August 16, 2008
2F-Brace					Page	2
$P_u =$	131.72	kip	(compression)			
$L_{brace} =$	8.1	ft				
k =	1.0	-				
Try section			(HSS-Square)	10.00	4	
	5.26	in ²	$I_x =$		in ⁴	
	9.16	in ³		19.00	in ⁴	
b =	5.00	in		5.00	in	
t _{nom} =	0.31	in	$t_{des} =$	0.291	in	
	1.90	in				
$r_y =$	1.90	in				
F_y (brace) =	46	ksi	$E_s =$	29000	ksi	
kL/r =	51.05	-	Limit =	100.43	OK	$Kl/r \le 4\sqrt{E/F_y}$
$F_e =$	109.81	ksi	$0.44 F_{y} =$	20.24	ksi	
$\phi =$	0.90	-				
$\phi P_n =$	182.74	kip	(compression)	Check	OK	
C	heck Comp	oactness S	eismically (AISC Seismi		ns 2005, Se	c 8.2b)
$\lambda_{ps} =$	16.07	-	b/t =	14.20	OK	
						(Table I-8-1)
			h/t =	14.20	OK	
φ =	0.90	_				
$\phi P_n =$	217.76	kip	(tension)	Check	OK	
- 11			(,)			

Title	TCBF	-B-1 Spec	cimen Design Calculation	Sheet	Date	August 16, 2008
1F-Brace					Page	3
$P_u =$	249.37	kip	(compression)			
$L_{brace} =$	9	ft				
	1.0	-				
Try section			(HSS-Square)	20.50	• •	
	7.58	in2		39.50	in4	
	15.80	in3		39.50	in4	
b =		in		6.00	in	
t _{nom} =		in	$t_{des} =$	0.349	in	
	2.28	in				
5	2.28	in				
F_y (brace) =		ksi		29000	ksi	
	47.37	-	Limit =		OK	$Kl/r \le 4\sqrt{E/F_y}$
	127.55	ksi	$0.44 \; F_y =$	20.24	ksi	
	0.90	-				
	269.85	kip	(compression)	Check	OK	
		oactness S	eismically (AISC Seismic			c 8.2b)
$\lambda_{ m ps} =$	16.07	-	b/t =	14.20	OK	
				1 (20	0.11	(Table I-8-1)
			h/t =	14.20	OK	
φ =	0.90	_				
	313.81	kip	(tension)	Check	OK	
- 11		1				

Title	TCBF	-B-1 Specin	men Design (Calculatio	n Sheet	Date	August	16, 2008
2F			lusset Plate C			Page		4
Brace]	HSS5x5x5/	16					
$R_yF_yA_g =$	338.74	kip	(T_u)					
$F_uA_g =$	305.08	kip	(P_u)	$T_u/P_u =$	1.11	-		
$R_yF_y =$	64.4	ksi						
$R_t F_u =$		ksi						
	0.9	-						
	0.75		apture in net s					
_	1.27	(Net secti	ion reinforcer	nent requi	ired!)			
$\phi_t =$	0.90	(tensile y	ield in gross s	section)				
t _{gusset} =	0.75	in	(estimated)		$F_y =$	50	ksi	
t _g =	0.75	in	(use)			(gusset	plate)	
					$F_u =$	65	ksi	
$A_{cut} =$	0.51	in^2						
$A_{net} =$	4.75	in^2						
$A_e =$	5.99	in ²	(Reinforcem	ent requir	red!)			
Reinforcement Plates								
1=	12	in	B =	5	in	H =	5	in
$x_bar =$	1.875	in	٨	5.00	. 2		7 10	. 2
U =	0.84	-	$A_{e, req} =$	5.99	in ²	$A_{net, req} =$	7.10	in ²
	1.17	in ²	(both sides)					
$b_{reinf} =$	2	in		0.00		Ŧ		
-	0.59	in	$t_{use} =$		in	$L_{plate} =$	14	in
$F_{y, plate} =$	50	ksi	$R_yF_yA_g =$		kip			
$L_{weld} =$	6	in		5	x 1/16 in	(fillet)		
$\phi R_n =$	83.51	kip	OK					
<u> </u>			Brook	e Block S	hoor			
t _{brace} =	0.291	in	Diact	DIUCK D	ncai			
$L_{req} =$	11.15	in	OK					
$L_{req} = L_{use} =$	11.15	in	UIX					
L _{use} –	12	111						
			Brace to (Gusset Pla	ate Weld			
$L_{weld} =$	12	in						
weld =	6	x 1/16 in	(fillet)					
weiu –	0		(initet)					

	70 42 400.87	ksi ksi kip	OK	
			Gusset Plate Block Shear	
A _{gv} =	18	in^2		
$A_{nt} =$	4.31	in ²		
$U_{bs} =$	1	-		
φ =	0.75	-		
$\phi R_n =$	615.23	kip	OK	
			Whitmore Effective Width	
$L_{whitmore}$ =	20.59	in	(theoretical width)	
$\phi =$	0.90	-		
$\phi R_n =$	694.86	kip	OK (check gross yield)	

Title	TCBF	-B-1 Specin	men Design (Calculation	n Sheet	Date	August	16, 2008
1F			Gusset Plate C			Page		5
Brace	-	HSS6x6x3/	/8					
$R_yF_yA_g =$	488.152	kip	(T_u)					
$F_uA_g =$	439.64	kip	(P_u)	$T_u/P_u =$	1.11	-		
5 5	64.4	ksi						
$R_t F_u =$		ksi						
	0.9	-	, . ,	、				
			apture in net s		11 \			
_	1.27		ion reinforcer		red!)			
	0.90		ield in gross s	section)		F 0		
t _{gusset} =	0.90	in	(estimated)		$F_y =$	50	ksi	
t _g =	0.75	in	(use)		_	(gusset		
	0.64	2			$F_u =$	65	ksi	
	0.61	in ²						
$A_{net} =$		in ²						
$A_e = 8.63$ in ² (reinforcement required)								
Reinforcement Plates								
l = x_bar =	14 2.25	in in	B =	6	in	H =	6	in
	0.84	-	$A_{a} =$	8 63	in ²	A _{net} reg =	10.29	in ²
	1.66	in ²	(both sides)	0.02	111	net, req	10.27	111
$b_{reinf} =$	3	in	()					
	0.55	in	$t_{use} =$	0.625	in	$L_{plate} =$	16	in
$F_{y, plate} =$	50	ksi	$R_y F_y A_g =$		kip	plate		
$L_{weld} =$	7	in	weld =	6	x 1/16 in	(fillet)		
$\phi R_n =$	116.92	kip	OK					
		Ĩ						
			Brace	e Block Sl	hear			
t _{brace} =	0.349	in						
$L_{req} =$	13.40	in	OK					
$L_{use} =$	14	in						
			Brace to (Gusset Pla	ate Weld			
$L_{weld} =$	14	in	((*11)					
weld =	7	x 1/16 in	(fillet)					
$\phi_b =$	0.75	-						

$F_{exx} = F_{w} = \phi_{b}R_{n} =$	70 42 545.63	ksi ksi kip	OK
			Gusset Plate Block Shear
A _{gv} =	21	in^2	
$A_{nt} =$	5.16	in ²	
$U_{bs} =$	1	-	
φ =	0.75	-	
$\phi R_n =$	723.87	kip	OK
			Whitmore Effective Width
$L_{whitmore} =$	23.90	in	(theoretical width)
$\phi =$	0.90	-	
$\phi R_n =$	806.55	kip	OK (check gross yield)

Title	TCBF	-B-1 Specir	nen Design Calculation	Sheet	Date	August	16, 2008
2F			eam Design Check		Page		5
$R_{y}F_{y}A_{g} = 0.3 P_{n} =$		kip kip	$\theta = \sin(\theta) = \cos(\theta) = \sin(\theta) = \sin(\theta$	0.73 0.67	(rad)	42.0	(deg)
H = P _u =	185.86 297.06 600.00 100.97	kip kip kip kip-ft	cos(θ) = (conservatively) (revised from structura				
Try	w24	1x117					
$A_g =$	34.4	in ²	b _f =	12.8	in		
$I_x =$	3540	in ⁴	$t_{\rm f} =$	0.85	in		
$I_y =$	297	in ⁴	d =	24.3	in		
$r_x =$	10.1	in	$t_w =$	0.55	in		
$r_y =$	2.94	in	$F_y =$	50	ksi		
$\lambda_{p1} =$	9.15		b/t =	7.53	Compact		
$\lambda_{p2} =$	90.55		h/tw =	41.09	Compact		
$L_p =$	10.38	ft		327	in ³		
c =	1	-		6.72	in ⁴		
C _w =	40800	in ⁶	h _o =		in		
$S_x =$	291	in ³	$r_{ts} =$	3.46	in		
$L_r =$	29.90	ft	Brace PT=	2	-		
$L_b =$	10	ft	C _b =	1.0	(Conserv	vatively)	
$M_p =$	1362.5	kip-ft	$F_{cr} =$	248.50	ksi		
$\phi_{\rm b} =$	0.90	-	$M_n =$	1362.50	kip-ft	(Need	Check)
$\phi_b M_n =$	1226.25	kip-ft					
k1/r =	40.82	_	k =	1.0	-		
	171.79	ksi	$0.44 F_{y} =$		ksi		
	0.90	-	3				
-	1370.46	kip					
$P_u/\phi_c P_n =$ Check	0.44 0.51	use (H1-1a <mark>OK</mark>	a)				

Title	TCBF	F-B-1 Specin	nen Design	Calculation	Sheet	Date	Augus	st 16, 2008
1F		Lower E	Beam Desig	gn Check		Page		7
$R_yF_yA_g =$	488.15	kip	(1F)					
$R_yF_yA_g =$	338.74	kip	(2F)	$\theta =$	0.73	(rad)	42.0	(deg)
$0.3 P_n =$	89.95	kip	(1F)	$\sin(\theta) =$	0.67			
$0.3 P_n =$	60.91	kip	(2F)	$\cos(\theta) =$	0.74			
	285.81	kip						
	317.56	kip						
	317.56	_	(conservat					
$M_u =$	170.85	kip-ft	(revised fr	rom structura	l analysis)	1		
Т		1						
Try	w2 20.1	4x08 in ²		b _f =	8.97	in		
$A_g = I_g = I_g$	1830	in in ⁴		$b_{\rm f} = t_{\rm f} =$		in		
					23.7			
5	70.4	in ⁴				in		
	9.55	in			0.415	in 1:		
$r_y =$	1.87	in		Г _у =	50	ksi		
$\lambda_{p1} =$	9.15			b/t =	7.67	Compact		
_	90.55			h/tw =		Compact		
_	6.61	ft			177	in ³		
р с =	1	-			1.87	in^4		
	9430	in ⁶			23.12	in		
	154	in ³			2.30	in		
	18.74	ft			2	-		
$L_b =$	10	ft			1.0	(Conserv	vatively)	
	737.5	kip-ft		-	110.86	ksi		
r	0.90	-			656.87			OK
$\phi_{b}M_{n} =$		kip-ft		11		•		
		*						
kl/r =	64.17	-		k =	1.0	-		
$F_e =$	69.50	ksi		$0.44 F_y =$	22	ksi		
$\phi_{\rm c} =$	0.90	-						
$\phi_c P_n =$	669.33	kip						
$P_u/\phi_c P_n =$ Check	0.47 0.73	use (H1-1a <mark>OK</mark>	u)					

Title	TCBF	-B-1 Specir	nen Design Calculation	Sheet	Date	August 16, 2008
2F		Colur	nn Design Check		Page	8
P _u = M _u =	42.58 126.56	kip kip-ft	(revised from structura (revised from structura			
$L_{column} =$	9	ft				
Try	w1	2x96				
A _g =	28.2	in ²	$b_f =$	12.2	in	
$I_x =$	833	in^4	$t_{f} =$	0.9	in	
$I_y =$	270	in^4	d =	12.7	in	
$r_x =$	5.44	in	$t_w =$	0.55	in	
$r_y =$	3.09	in	$F_y =$	50	ksi	
$\lambda_{p1} =$	7.22	_	b/t =	6.78	Compact	
	71.71	_	h/tw =	19.82	Compact	
$L_p =$	10.91	ft		147	in ³	
с =	10.71	-		6.85	in ⁴	
C _w =	9410	in ⁶	$h_{o} =$	11.80	in	
$S_x =$	131	in ³	$r_{ts} =$		in	
$L_r =$	40.86	ft		0	-	
$L_b =$	9	ft	$C_b =$		(Conserv	vatively)
M _p =	612.5	kip-ft	$F_{cr} =$	344.49	ksi	
$\phi_{b} =$	0.90	-	$M_n =$	612.50	kip-ft	(Need Check)
	551.25	kip-ft	C _a =	0.03	-	
$\frac{1}{1}r - \frac{1}{2}r$	34.95		k =	1.0		
	234.28	ksi	$K = 0.44 F_y =$	22	- ksi	
	0.90	-	0y		Kör	
	1160.56	kip				
$P_u/\phi_c P_n =$		use (H1-1)	0)			
Check	0.25	OK				

Title	TCBF	-B-1 Specin	nen Design Calculation	Sheet	Date	August 16, 2008
1F			nn Design Check		Page	9
D	404.10	1.		1 1 . \		
$P_u =$	484.19	_	(revised from structura			
$M_u =$	274.18	kip-ft	(revised from structura	l analysis)		
Τ	9	ft				
$L_{column} =$	2	It				
Try	w1	2x96				
$A_g =$	28.2	in^2	$b_f =$	12.2	in	
$I_x =$	833	in^4	$t_f =$	0.9	in	
$I_y =$	270	in^4	d =	12.7	in	
$r_x =$	5.44	in	$t_w =$	0.55	in	
$r_y =$	3.09	in	$F_y =$	50	ksi	
2	7.00		1.4	(70		
1	7.22	-	b/t =	6.78	Compact	
	52.56	- 0	h/tw =	19.82	Compact	
~	10.91	ft		147	in ³	
c =	1	-	J =	6.85	in ⁴	
	9410	in ⁶	h _o =	11.80	in	
$S_x =$	131	in ³	$r_{ts} =$	3.49	in	
$L_r =$	40.86	ft	Brace PT=	0	- (Consorr	votivaly)
$L_b =$	9	ft	$C_b =$	1.0		vatively)
_	612.5	kip-ft		344.49	ksi	(Need Cheels)
-	0.90	-			к1р-п	(Need Check)
$\varphi_{b} W_{n} \equiv$	551.25	kip-ft	C _a =	0.38	-	
kl/r =	34.95	-	k =	1.0	-	
$F_e =$	234.28	ksi	0.44 F _y =	22	ksi	
$\phi_c =$	0.90	-				
$\phi_c P_n =$	1160.56	kip				
	0.12	/*** *	、 、			
		use (H1-1a	ι)			
Check	0.86	OK				

		Check Column Web Shear Stress
$\begin{split} M_{p} &= 7350 \\ L &= 96.15 \\ V &= 152.89 \\ A_{s} &= 6.99 \\ S_{v} &= 21.89 \\ S_{v, \ yield} &= 29.00 \end{split}$	kip-in in kip in ² ksi ksi	$A_s = d*tw$ Elastic

Title	TCBF	-B-1 Specin	men Design C	alculation	Sheet	Date	August 16,	2008
2F			Column Conne			Page	10	
Type H = V = M =		(WUF-B) kip kip kip-ft	(revised from	n structura	l analysis)	0		3
$R_u =$	175.21	kip					Ro	=
Try d _b =	0.88	in	$F_u =$	150	ksi	_		
$A_b =$	0.60	in ²	$F_{nv} =$	75	ksi	(threads ex	cluded)	
$N_b =$	6	bolts	(in one row)					
$R_n =$	270.59	kip	(bolt shear)		$L_{c_{ex}} =$	1.5	in	
$\phi_b =$	0.75	-			$L_{c_{in}} =$	3	in	
$\phi_b R_n =$	202.94	kip	OK					
L _{c2} = t = R _n =	1.03 2.06 0.50 1227.66	in in in kip	(edge clear d (clear distanc (shear tab thi (combined be	ce) ickness)	$R_{n2} =$		kip kip	
	0.75 920.74	- kip	OK					
L _{tab} =	18	in	$A_{s, tab} =$	9	in ²	$R_n =$	524.79	kip
w _{tab} =	4.5	in	$F_{y, tab} =$	50	ksi	$P_{nt} =$	450.00	kip
			$F_{v, tab} =$	30.0	ksi	$P_{nv} =$	270.00 <mark>OK</mark>	kip
Weld	Fillet	(shea	ar tab)					
$F_{exx} =$	70	ksi			334.06	kip		
Fw =	42	ksi		-	0.75	-		
w =	5	x 1/16	inch	$\phi_b R_n =$	250.54	kip	OK	
L _{weld} = side =	18 2	in sides						
Weld	CJP	(top, bott	om flanges)					
$b_f =$	12.8	in		$F_{y, bm} =$	50	ksi	(base metal)	
$t_{\rm f}$ =	0.85	in		$M_n =$	1063.07	kip-ft	OK	
d =	24.3	in						
$t_{\rm w} =$	0.55	in						

		Check Block Shear	
		Check Block Shear	
Beam			
w24x117			
$A_{gv} = 9.9$	in ²		
$A_{gt} = 1.925$	in ²		
$A_{nv} = 6.6$	in^2		
$A_{nt} = 1.65$	in ²		
$U_{bs} = 0.5$	-		
$\phi = 0.75$	-		
$F_y = 50$	ksi		
$F_{u} = 65$	ksi		
$\phi R_n = 233.27$	kip	OK	
~ ~ .			
Shear Tab	2		
$A_{gv} = 8.25$	in ²		
$A_{gt} = 1.5$	in^2		
$A_{nv} = 5.5$	in ²		
$A_{nt} = 1.25$	in ²		
$U_{bs} = 0.5$	-		
$\phi = 0.75$	-		
$F_y = 50$	ksi		
$F_u = 65$	ksi		
$\phi R_n = 191.34$	kip	OK	

2F Braces to Beam Connection Page 11 Braces HSS5x5x5/16 T T 338.74 kip sin(θ) = 0.669 C 312.69 kip cos(θ) = 0.743 e 11 in Shear = 484.21 kip cos(θ) = 0.743 e 12.15 in in <th>Title</th> <th>TCBF</th> <th>-B-1 Speci</th> <th>men Design</th> <th>Calculation</th> <th>Sheet</th> <th>Date</th> <th>August 16, 2008</th>	Title	TCBF	-B-1 Speci	men Design	Calculation	Sheet	Date	August 16, 2008
$T = 338.74 kip sin(\theta) = 0.669 cos(\theta) = 0.743 e = 12.15 in Shear = 484.21 kip cos(\theta) = 0.743 e = 0.743 e = 0.75 in L = 60 in sv = 10.76 ksi sa = 3.77 ksi sa = 3.77 ksi sa = 13.07 ksi a = 0.9 - F_{y, guest} = 50 ksi Ratio = 0.56 OK L_{whitmere} = 20.59 in L_{r,min} = 57.78 in (geometry limit) OK L_{v, min} = 15.30 in (geometry limit) OK L_{v, min} = 15.30 in (geometry limit) OK U_{whitmere} = 20.59 in A_v = 12 in^2 m_{kov} = 20.92 in A_v = 324 kip OK OK M_{kn} = 694.86 kip OK Gusset Plate to Beam Flange Use Gusset Plate to Beam Flange Use Gusset Plate to Beam Flange Gusset Plate to Beam Flange Gusset Plate to Beam Flange Gusset Plate OK Ksi F_w = 42 ksi sv = 11.41 ksi si sv = 11.41 ksi si si f_w = 0.354 in f_{avg} = 18.15 ksi f_{avg} = 18.15 ksi f_{avg} = 18.15 ksi f_{avg} = 10.75 - f_r = 22.68 ksi Ratio = 0.77 OK Check Beam Web Check Beam Web$							1	
$C = 312.69 kip \\ c = 12.15 in \\ Shear = 484.21 kip \\ Tension = 169.56 kip \\ Moment = 490.26 kip \\ L_{gasset} = 0.75 in \\ L_{gasset} = 0.75 ksi \\ s_A = 3.77 ksi \\ s_M = 13.07 ksi \\ \phi = 0.9 - \\ F_{y, gasset} = 50 ksi \\ Ratio = 0.56 OK \\ \\ L_{whitmore} = 20.59 in \\ L_{w, gasset} = 50 ksi \\ Ratio = 0.56 OK \\ \\ L_{whitmore} = 20.59 in \\ L_{w, min} = 15.30 in \\ (geometry limit) OK \\ L_{v} = 16 in \\ L_{v, min} = 15.30 in \\ (geometry limit) OK \\ W_{up} = 10.29 in \\ W_{up} = 10.29 in \\ Whitm_{eff} = 20.59 in \\ \phi R_n = 324 kip \\ \phi R_n = 694.86 kip \\ Weld \\ Fillet \\ F_{exx} = 70 ksi \\ F_w = 42 ksi \\ F_w = 42 ksi \\ Kip \\ Weld \\ Fillet \\ F_{exx} = 70 ksi \\ F_w = 42 ksi \\ L_{weid} = 60 in \\ S_A = 4.00 ksi \\ I_{weid} = 60 in \\ S_A = 4.00 ksi \\ side = 2 sides \\ f_{peak} = 21.20 ksi \\ t_{eff} = 0.354 in \\ f_{avg} = 18.15 ksi \\ \phi = 0.75 - \\ f_r = 22.68 ksi \\ Ratio = 0.77 OK Ratio = 0.72 OK \\ \hline \end{array}$	Braces	H	HSS5x5x5/	16				
$c = 12.15 \text{ in } \\ \text{Shear = 484.21 kip } \\ \text{Tension = 169.56 kip } \\ \text{Moment = 490.26 kip-ft} \\ \text{I}_{gusset} = 0.75 \text{ in } \\ \text{L = 60 } \\ \text{in } \\ \text{sv = 10.76 ksi} \\ \text{sA = 3.77 ksi} \\ \text{sM = 13.07 ksi} \\ \phi = 0.9 \\ \text{F}_{y, gusset} = 50 \\ \text{Ksi} \\ \text{Ratio = 0.56 } \text{OK} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	T =	338.74	kip	$\sin(\theta) =$	0.669			
Shear = 484.21 kip Tension = 169.56 kip Moment = 490.26 kip-ft $t_{gusset} = 0.75$ in L = 60 in $s_V = 10.76$ ksi $s_A = 3.77$ ksi $s_M = 13.07$ ksi $\phi = 0.9$ - $F_{y, gusset} = 50$ ksi Ratio = 0.56 OK $L_{whitmore} = 20.59$ in $L_{min} = 57.78$ in (geometry limit) OK $L_v = 16$ in $L_v, min = 15.30$ in (geometry limit) OK $w_{up} = 10.29$ in $A_v = 12$ in ² $w_{low} = 20.92$ in $P_u = 226.61$ kip Whitm _{eff} = 20.59 in $\phi R_n = 324$ kip OK $\phi R_n = 694.86$ kip OK U U Weld Fillet $F_{exx} = 70$ ksi $F_w = 42$ ksi $s_V = 11.41$ ksi $w = 8$ x 1/16 inch $s_M = 13.87$ ksi $L_welat = 60$ in $s_A = 4.00$ ksi side $= 2$ sides $f_{peak} = 21.20$ ksi $t_{eff} = 0.354$ in $f_{avg} = 18.15$ ksi $\phi = 0.75$ - $f_r = 22.68$ ksi Ratio = 0.77 OK Ratio = 0.72 OK	C =	312.69	kip	$\cos(\theta) =$	0.743			
Tension = 169.56 kip Moment = 490.26 kip-ft $I_{pusset} = 0.75$ in L = 60 in $s_v = 10.76$ ksi $s_A = 3.77$ ksi $s_M = 13.07$ ksi q = 0.9 - $F_{y, gusset} = 50$ ksi Ratio = 0.56 OK Lwhitmore = 20.59 in L _{min} = 57.78 in (geometry limit) OK $L_v = 16$ in $L_v, min = 15.30$ in (geometry limit) OK $w_{up} = 10.29$ in $A_v = 12$ in ² $w_{hov} = 20.92$ in $P_u = 226.61$ kip Whitm _{eff} = 20.59 in $\phi R_n = 324$ kip OK $\phi R_n = 694.86$ kip OK Cusset Plate to Beam Flange Weld Fillet $F_{exx} = 70$ ksi $F_w = 42$ ksi $s_V = 11.41$ ksi $w = 8$ x 1/16 inch $s_M = 13.87$ ksi $L_{weat} = 60$ in $s_A = 4.00$ ksi side = 2 sides $f_{peak} = 21.20$ ksi $t_{eff} = 0.354$ in $f_{avg} = 18.15$ ksi $\phi = 0.75$ - $f_r = 22.68$ ksi Ratio = 0.77 OK Ratio = 0.72 OK								I
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$			-					
$ \begin{array}{c} t_{gusset} = & 0.75 & \text{in} \\ L = & 60 & \text{in} \\ s_{V} = & 10.76 & \text{ksi} \\ s_{A} = & 3.77 & \text{ksi} \\ s_{M} = & 13.07 & \text{ksi} \\ \phi = & 0.9 & - \\ F_{y, gusset} = & 50 & \text{ksi} \\ \text{Ratio} = & 0.56 & \text{OK} \end{array} $ $ \begin{array}{c} L_{\text{whitmore}} = & 20.59 & \text{in} & L_{\text{min}} = & 57.78 & \text{in} & (\text{geometry limit}) & \text{OK} \\ L_{w} = & 16 & \text{in} & L_{v, \min} = & 15.30 & \text{in} & (\text{geometry limit}) & \text{OK} \\ L_{v} = & 16 & \text{in} & L_{v, \min} = & 15.30 & \text{in} & (\text{geometry limit}) & \text{OK} \\ \\ W_{up} = & 10.29 & \text{in} & A_{v} = & 12 & \text{in}^{2} \\ w_{low} = & 20.92 & \text{in} & P_{u} = & 226.61 & \text{kip} \\ \\ Whitm_{eff} = & 20.59 & \text{in} & \phi R_{n} = & 324 & \text{kip} & \text{OK} \\ \\ \hline \end{array} $ $ \begin{array}{c} \hline \\ \hline $				Ļ				
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$							-	
	_				←	/L		e = 0.5 d
	$s_V =$	10.76	ksi	/	\sim			\backslash
$ \begin{split} \varphi &= \begin{array}{c} 0.9 \\ F_{y, gusset} &= 50 \\ Ratio &= 0.56 \end{array} \\ Ki \\ Ratio &= 0.56 \end{array} \\ OK \\ \\ L_{whitmore} &= 20.59 \\ L_v &= \begin{array}{c} 16 \\ in \end{array} \\ L_{v, min} &= 15.30 \\ L_{v, min} &= 15.30 \end{array} \\ in (geometry limit) \end{array} \\ OK \\ \\ W_{up} &= 10.29 \\ M_{uow} &= 20.92 \\ in \\ W_{uow} &= 20.92 \\ in \\ W_{u} &= \begin{array}{c} 12 \\ m_{u} &= 226.61 \\ m_{u} &= 226.61 \\ m_{u} &= 324 \\ m_{u} &= \begin{array}{c} 0K \\ M_{u} &= \end{array} \\ M_{u} &= \begin{array}{c} 0K \\ M_{u} &= \begin{array}{c} 0K \\ M_{u} &= \begin{array}{c} 0K \\ M_{u} &= \end{array} \\ M_{u} &= \begin{array}{c} 0K \\ M_{u} &= \begin{array}{c} 0K \\ M_{u} &= \end{array} \\ M_{u} &= \begin{array}{c} 0K \\ M_{u} &= \end{array} \\ M_{u} &= \begin{array}{c} 0K \\ M_{u} &= \begin{array}{c} 0K \\ M_{u} &= \end{array} \\ M_{u} &= \begin{array}{c} 0K \\ M_{u} &= \end{array} \\ M_{u} &= \begin{array}{c} 0K \\ M_{u} &= \end{array} \\ M_{u} &= \begin{array}{c} 0K \\ M_{u} &= \end{array} \\ M_{u} &= \begin{array}{c} 0K \\ M_{u} &= \end{array} \\ M_{u} &= \begin{array}{c} 0K \\ M_{u} &= \end{array} \\ M_{u} &= \begin{array}{c} 0K \\ M_{u} &= \end{array} \\ M_{u} &= \begin{array}{c} 0K \\ M_{u} &= \end{array} \\ M_{u} &= \end{array} \\ M_{u} &= \begin{array}{c} 0K \\ M_{u} &= \end{array} \\ M_{u} &= \begin{array}{c} 0K \\ M_{u} &= \end{array} \\ M_{u} &= \end{array} \\ M_{u} &= \begin{array}{c} 0K \\ M_{u} &= \end{array} \\ M_{u} &= \begin{array}{c} 0K \\ M_{u} &= \end{array} \\ M_{u} &= \end{array} \\ M_{u} &= \begin{array}{c$	$s_A =$	3.77	ksi	ζ	\Box	\smile		<pre>></pre>
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	$s_M =$	13.07	ksi		X		X	\mathbf{X}
Ratio = 0.56 OK $L_{whitmore}$ = 20.59 in L_{min} 57.78 in (geometry limit) OK L_v = 16 in $L_{v, min}$ 15.30 in (geometry limit) OK w_{up} = 10.29 in A_v = 12 in ² w_{low} = 20.92 in P_u = 226.61 kip Whitm _{eff} = 20.59 in ϕR_n 324 kip OK Gusset Plate to Beam Flange Weld Fillet F_{exx} 70 ksi F_w 42 ksi sv 11.41 ksi $w = 8$ x 1/16 inch s_M 13.87 ksi L_{weld} = 60 in s_A 4.00 ksi side = 2 sides f_{peak} 21.20 ksi t_{eff} 0.354 in f_{avg} 18.15 ksi	φ =	0.9	-		/			
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$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Ratio =	0.56	OK					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$								
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$L_{whitmore}$ =	20.59	in	$L_{min} =$	57.78	in	(geometry	limit) OK
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	$w_{up} =$	10.29	in	$A_v =$	12	in ²		
	$w_{low} =$	20.92	in	$P_u =$	226.61	kip		
$ \begin{split} \varphi R_n &= \ 694.86 \ \ kip \ \ OK \\ \hline \\ \hline \\ \hline \\ Gusset Plate to Beam Flange \\ \hline \\ \hline \\ Weld \ \ Fillet \\ F_{exx} &= \ 70 \ \ ksi \\ F_w &= \ 42 \ \ ksi \ \ s_V &= \ 11.41 \ \ ksi \\ w &= \ 8 \ \ x \ 1/16 \ \ inch \ \ s_M &= \ 13.87 \ \ ksi \\ L_{weld} &= \ 60 \ \ in \ \ s_A &= \ 4.00 \ \ ksi \\ side &= \ 2 \ \ sides \ \ f_{peak} &= \ 21.20 \ \ ksi \\ t_{eff} &= \ 0.354 \ \ in \ \ f_{avg} &= \ 18.15 \ \ ksi \\ \phi &= \ 0.75 \ \ - \ \ f_r &= \ 22.68 \ \ ksi \\ Ratio &= \ 0.77 \ \ OK \ \ Ratio &= \ 0.72 \ \ OK \\ \hline \\ \hline \\ \hline \hline \hline \\ \hline \hline \\ \hline \hline \hline \\ \hline \hline \\ \hline \hline \\ \hline \hline \hline \\ \hline \hline \hline \\ \hline \hline \hline \\ \hline \hline \hline \hline \\ \hline \hline \hline \hline \hline \\ \hline \hline$			in	$\phi R_n =$	324	kip	ОК	
Gusset Plate to Beam FlangeWeldFillet $F_{exx} = 70$ ksi $F_w = 42$ ksi $w = 8$ x 1/16 inch $s_M = 13.87$ ksi $L_{weld} = 60$ in $s_A = 4.00$ ksiside = 2sides $f_{peak} = 21.20$ ksi $t_{eff} = 0.354$ in $f_{avg} = 18.15$ ksi $\phi = 0.75$ - $f_r = 22.68$ ksiRatio = 0.77OKCheck Beam Web			kip					
Weld Fillet $F_{exx} =$ 70 ksi $F_w =$ 42 ksi $s_V =$ 11.41 ksi $w =$ 8 x 1/16 inch $s_M =$ 13.87 ksi $L_{weld} =$ 60 in $s_A =$ 4.00 ksi side = 2 sides $f_{peak} =$ 21.20 ksi $t_{eff} =$ 0.354 in $f_{avg} =$ 18.15 ksi $\phi =$ 0.75 - $f_r =$ 22.68 ksi Ratio = 0.77 OK Ratio = 0.72 OK	111	07 1100	шр	0 II				
Weld Fillet $F_{exx} =$ 70 ksi $F_w =$ 42 ksi $s_V =$ 11.41 ksi $w =$ 8 x 1/16 inch $s_M =$ 13.87 ksi $L_{weld} =$ 60 in $s_A =$ 4.00 ksi side = 2 sides $f_{peak} =$ 21.20 ksi $t_{eff} =$ 0.354 in $f_{avg} =$ 18.15 ksi $\phi =$ 0.75 - $f_r =$ 22.68 ksi Ratio = 0.77 OK Ratio = 0.72 OK				Gusset Pl	ate to Bean	n Flange		
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$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$F_{exx} =$	70	ksi					
$w =$ 8 x 1/16 inch $s_M =$ 13.87 ksi $L_{weld} =$ 60 in $s_A =$ 4.00 ksi side = 2 sides $f_{peak} =$ 21.20 ksi $t_{eff} =$ 0.354 in $f_{avg} =$ 18.15 ksi $\phi =$ 0.75 - $f_r =$ 22.68 ksi Ratio = 0.77 OK Ratio = 0.72 OK		42	ksi		$s_V =$	11.41	ksi	
$L_{weld} =$ 60 in $s_A =$ 4.00 ksi side = 2 sides $f_{peak} =$ 21.20 ksi $t_{eff} =$ 0.354 in $f_{avg} =$ 18.15 ksi $\phi =$ 0.75 - $f_r =$ 22.68 ksi Ratio = 0.77 OK Ratio = 0.72 OK				inch				
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$\phi = \begin{array}{ccc} 0.75 & - & f_r = 22.68 & ksi \\ Ratio = 0.77 & OK & Ratio = 0.72 & OK \\ \hline Check Beam Web \end{array}$	-							
Ratio = 0.77 OK Ratio = 0.72 OK Check Beam Web					-			
Check Beam Web					_			
	ixauo =	0.77	UK		Katio =	0.72	UK	
				Che	ck Beam W	Veb		
	width =	60	in	Beam		w24x117	1	

$R_{n} =$	196.10	kip	d =	24.3	in	t _w =	0.55	in
N =	30	in		0.85	in	$F_{y, web} =$		ksi
$\phi =$	0.75	-		1060.63	kip	• •	795.47	kip
	1.35	in	11	1000.05	мр		ppling)	OK
$\phi =$	1.00	-	R., =	1010.63	kip		1010.63	kip
Υ	1.00		11	1010.02	мр	(web local		OK
			Check Gu	isset Plate	Buckling	`		-
L _{gb} =	17.68	in	kL/r =	98.0	-	$L_c =$	14.13	in
k =	1.2	-	$F_e =$	29.82	ksi	$L_{c1} =$	11.38	in
r =	0.217	in	$0.44 F_y =$	22	ksi	$L_{c2} =$	16.94	in
A _g =	15.44	in^2	$R_n =$	382.72	kip	$L_{max} =$	24.06	in
φ =	0.9	-	$\phi R_n =$	344.45	kip	$L_{tip} =$	21.88	in
					OK	$L_{ave} =$	17.68	in
			Free	Edge Bucl	kling			
$L_e =$	15.63	in						
$L_e/t_g =$	20.83	-						
Limit =	18.06	-	Edge stiffer	ner require	d!			
			т. 1	0, 1, 11,	(D			
M —	1400 75	1-:		Stability o		T _	10	C.
	1498.75	kip-ft	Z =		in ³	$L_b =$	10	ft A
-	1	-		23.45	in 1-in/in		17.05	ft
	15.34	kip	$\beta_{br} =$	85.22	kip/in		1	OK
(Nodal)			(Nodal)			$C_b =$	1	-
$M_{\rm br} =$	17.985	kip-ft						
$P_{br} =$	9.20	kip	(torsional)					
			β_{sec} not i	ncluded				
_			(torsional)					
	0.18	in	()					
				Kicker				
L3x2		2						
$A_g =$	1.73	in ²						
L =	25 2006 8	in Isia (in						
$k_{axial} =$	2006.8	kip/in kip/in	OV					
k =	1419	kip/in	OK					
L								

IF Beam-Column-Gusset Connections Page 12 Big Gusset Plate for Upper Ploor Bracing and Lower Ploor Bracing	Title	Т	CBF-B-1	Specimen Design Calc	ulation Sheet	Date	August 16, 2008
$ \begin{array}{c c c c c c c c c } \hline Sway to Right & cos(\theta_{1}) = 0.743 \\ \hline F_{12R} = 461.74 & kip \\ \hline F_{12R} = 312.69 & kip \\ \hline F_{12L} = 312.69 & kip \\ \hline F_{12L} = 488.15 & kip \\ Beam & w24x68 \\ d = 23.7 & in \\ L_{c,min} = 56.77 & in \\ Column & w12x96 \\ c_{c} = 6.35 & in \\ R_{bcan} = 22.51 & kip \\ Column & w12x96 \\ r_{c} = 0.75 & in \\ \hline L_{c,min} = 15.30 & in \\ \hline L_{c,min} = 15.99 & in \\ L_{c,min} = 15.30 & in \\ \hline L_{c} = 18 & in \\ L_{c} = 18 & in \\ L_{c} = 23.7 & in \\ L_{c} = 23.7 & in \\ \hline L_{c} = 18 & in \\ L_{c} = 23.7 & in \\ \hline L_{c} = 18 & in \\ L_{c} = 18 & in \\ L_{c} = 18 & in \\ L_{c} = 23.7 & in \\ \hline L_{c} = 18 & in \\ L_{c} = 18 & in \\ L_{c} = 18 & in \\ \hline L_{c} = 23.7 & in \\ \hline L_{c} = 23.8 & in \\ \hline L_{c} = 18 & in \\ \hline L_{c} = 218 & in \\ \hline L_{c} = 18 & in \\ \hline L_{c} = 218 & kip \\ \hline L_{c} = 218 & kip \\ \hline L_{c} = 18 & kip \\ \hline L_{c} = 100 & kip \\ \hline$	1F		Beam	-Column-Gusset Conn	ections	Page	12
$ \begin{array}{c} F_{U2R} = 338.74 & kip \\ F_{U2R} = 338.74 & kip \\ F_{L2R} = 461.74 & kip \\ \hline F_{U2L} = 312.69 & kip \\ F_{U2L} = 488.15 & kip \\ Beam & w24x68 \\ d = 23.7 & in \\ L_{c, min} = 56.77 & in \\ Column & w12x96 \\ c_{c} = 6.35 & in \\ R_{beam} = 22.51 & kip \\ (downward) \\ L_{a, min} = 15.30 & in \\ L_{cd, min} = 15.30 & in \\ L_{cd} = 18 & in \\ L_{cd} = 18 & in \\ L_{cd} = 23 & in \\ L_{cd} = 18 & in \\ L_{cd} = 18 & in \\ L_{cd} = 23 & in \\ L_{cd} = 18 & in \\ L_{cd} = 23 & in \\ L_{cd} = 18 & in \\ L_{cd} = 11.46 & ksi \\ L_{cd} = 12.179 & kip \\ L_{cd} = 11.46 & ksi \\ L_{cd} = 21.79 & kip \\ L_{cd} = 154.67 & kip \\ (upward) \\ M = 271.45 & kip-ft \\ (counter-clockwise) \\ \hline \begin{array}{c} Column-Side \\ Column-Side \\ V_{cd} = 51.298 & kip \\ M = 271.45 & kip-ft \\ (counter-clockwise) \\ \hline \begin{array}{c} Column-Side \\ V_{cd} = 51.11 & ksi \\ f_{1} = 5.48 & kip/in \\ (leftward) \\ S_{A} = 5.11 & ksi \\ F_{ad} = 2.04 & ksi \\ H_{cu} = 68.95 & kip \\ (leftward) \\ S_{A} = 4.17 & ksi \\ \end{array}$		Bi	g Gusset I	Plate for Upper Floor B	racing and Lower Fl	oor Bracing	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Sv	vay to Rig	ht		ve. Vu	J F _U	
$\begin{array}{c c c c c c c } \hline F_{12R} = 461.74 & kip & cos(\theta_{L}) = 0.743 \\ \hline Sway to Left & \\ \hline F_{12R} = 312.69 & kip & \\ \hline F_{12R} = 488.15 & kip & \\ Beam & w24x68 & \\ d = 23.7 & in & \\ L_{c, min} = 56.77 & in & \\ Column & w12x96 & \\ e_{c} = 6.35 & in & \\ R_{beam} = 22.51 & kip & (downward) & \\ L_{b, min} = 15.30 & in & \\ L_{cu, min} = 15.30 & in & \\ L_{cu, min} = 17.76 & in & \\ t_{g} = 0.75 & in & \\ L_{cu} = 18 & in & (use) & F_{y, gusst} = 50 & ksi & \\ L_{cd} = 18 & in & (use) & \\ L_{e} = 23 & in & (use) & \\ \hline & & & \\ V_{U2R} = 226.61 & kip & (upward) & s_{M} = 7.31 & ksi & \\ V_{L2R} = 226.61 & kip & (upward) & s_{M} = 7.31 & ksi & \\ V_{L2R} = 308.89 & kip & (upward) & s_{M} = 7.31 & ksi & \\ V_{L2R} = 308.89 & kip & (upward) & s_{A} = 2.04 & ksi & \\ H_{L2R} = 343.21 & kip & (leftward) & Ratio = 0.49 & - & OK & \\ V_{coul} = 154.67 & kip & (downward) & s_{A} = 5.11 & ksi & \\ F_{u} = 512.98 & kip & (upward) & s_{M} = 22.146 & ksi & \\ F_{u} = 154.67 & kip & (downward) & s_{M} = 2.20 & ksi & \\ F_{u} = 68.95 & kip & (leftward) & Ratio = 0.47 & - & OK & \\ V_{vol} = 71.94 & kip & (leftward) & Ratio = 0.47 & - & OK & \\ V_{vol} = 71.94 & kip & (downward) & s_{A} = 4.17 & ksi & \\ \end{array}$	$F_{U2R} =$	338.74	kip	-		Hu	
$ \begin{array}{c} F_{U2L} = 312.69 kip \\ F_{L2L} = 488.15 kip \\ Beam & w24x68 \\ d = 23.7 in \\ L_{c, min} = 56.77 in \\ Column & w12x96 \\ e_c = 6.35 in \\ R_{beam} = 22.51 \\ L_{b, min} = 15.99 in \\ L_{c, min} = 17.76 in \\ t_c = 0.75 in \\ L_{c, min} = 17.76 in \\ t_c = 0.75 in \\ L_{c} = 18 in (use) \\ F_{y, gasset} = 50 ksi \\ L_{cl} = 18 in (use) \\ L_{b} = 23 in (use) \\ L_{b} = 23 in (use) \\ L_{b} = 23 in (use) \\ \hline \\ V_{U2R} = 226.61 kip (upward) \\ S_{L} = 59.7 in (use) \\ L_{b} = 23 in (use) \\ \hline \\ V_{U2R} = 226.61 kip (upward) \\ S_{L} = 251.79 kip (rightward) \\ S_{L} = 251.79 kip (rightward) \\ S_{L} = 251.79 kip (rightward) \\ S_{L} = 21.79 kip (upward) \\ S_{L} = 2.14 kip (leftward) \\ M_{12R} = 343.21 kip (leftward) \\ M_{12R} = 512.98 kip (upward) \\ M_{2} = 271.45 kip.ft (counter-clockwise) \\ \hline \\ V_{cu} = 154.67 kip (downward) \\ S_{L} = 5.11 ksi \\ f_{1} = 5.48 kip/in (leftward) \\ S_{L} = 5.11 ksi \\ f_{2} = 2.18 kip/in (leftward) \\ S_{L} = 5.11 ksi \\ f_{2} = 2.18 kip/in (leftward) \\ S_{L} = 2.20 ksi \\ H_{cu} = 68.95 kip (leftward) \\ Ratio = 0.47 OK \\ H_{uu} = 182.84 kip (leftward) \\ S_{A} = 4.17 ksi \\ \end{array}$	$F_{L2R} =$	461.74	kip	$\cos(\theta_{\rm L}) = 0.743$			
$ \begin{array}{c} F_{121} = 512.69 & kip \\ F_{121} = 488.15 & kip \\ Bcam & w24x68 \\ d = 23.7 & in \\ L_{c, min} = 56.77 & in \\ Column & w12x96 \\ e_c = 6.35 & in \\ R_{beam} = 22.51 & kip \\ c_{c} = 6.35 & in \\ R_{beam} = 15.99 & in \\ L_{cu, min} = 15.30 & in \\ L_{cu, min} = 15.30 & in \\ L_{cu, min} = 17.76 & in \\ L_{cu} = 18 & in \\ L_{cu} = 18 & in \\ L_{cu} = 18 & in \\ L_{cu} = 23.7 & in \\ L_{cu} = 251.79 & kip \\ W_{U2R} = 226.61 & kip \\ W_{U2R} = 230.889 & kip \\ W_{U2R} = 230.889 & kip \\ W_{U2R} = 308.89 & kip \\ W_{U2R} = 308.89 & kip \\ W_{L2R} = 308.89 & kip \\ W_{L2R} = 343.21 & kip \\ W_{L2R} = 343.21 & kip \\ W_{L2R} = 154.67 & kip \\ W_{Watd} \\ M = 271.45 & kip-ft \\ Column-Side \\ W_{val} = 512.98 & kip \\ W_{Watd} \\ M = 271.45 & kip-ft \\ W_{U2R} = 154.67 & kip \\ W_{Watd} \\ M = 271.45 & kip-ft \\ W_{Watd} \\ M = 272.0 & ksi \\ H_{Wat} \\ M \\ $			Ìt				-0.5(H + H)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$F_{U2L} =$	312.69	kip		W.D. Minuter R	beam	$-0.3(H_{\rm U}+H_{\rm L})$
$\begin{array}{cccccccccccccccccccccccccccccccccccc$			-		W.F	ź	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$					V _{total}		
Column w12x96 $e_c = 6.35$ in $R_{betan} =$ 22.51 kip (downward) $L_{b,min} =$ 15.99 in $M_{merice} = V_{mal} + e_e$ $L_{cu,min} =$ 15.30 in $W_{merice} = V_{mal} + e_e$ $L_{cu,min} =$ 15.30 in $W_{merice} = V_{mal} + e_e$ $L_{cu,min} =$ 17.76 in $W_{merice} = V_{mal} + e_e$ $L_{cu} =$ 18 in (use) $V_{y,gusset} =$ 50 ksi $L_{cl} =$ 18 in (use) $V_{y,gusset} =$ 50 ksi $L_{cl} =$ 23 in (use) $V_{y,gusset} =$ 50 ksi $U_{12R} =$ 226.61 kip (upward) $S_V =$ 11.46 ksi $W_{12R} =$ 308.89 kip (upward) $S_A =$ 2.04 ksi $W_{12R} =$ 308.89 kip (upward) $S_A =$ 2.04 ksi $W_{12R} =$ 343.21 kip (leftward) Ratio = 0.49 OK $W_{ual} =$ 51.298						 ◀	$- 0.5 (H_U + H_L)$
$\begin{array}{cccc} c_{c} & 6.35 & \text{in} \\ r_{beam} = & 22.51 & \text{kip} & (downward) \\ l_{b, \min} = & 15.99 & \text{in} \\ l_{cu, \min} = & 15.30 & \text{in} \\ l_{cu, \min} = & 17.76 & \text{in} \\ l_{cu, \min} = & 17.76 & \text{in} \\ l_{cu} = & 18 & \text{in} & (use) & F_{y, \text{ gasset}} = & 50 & \text{ksi} \\ l_{cl} = & 18 & \text{in} & (use) \\ l_{c} = & 59.7 & \text{in} & (use) \\ l_{c} = & 59.7 & \text{in} & (use) \\ \hline \\ \hline \\ V_{U2R} = & 226.61 & \text{kip} & (upward) & s_{V} = & 11.46 & \text{ksi} \\ H_{U2R} = & 251.79 & \text{kip} & (rightward) & s_{M} = & 7.31 & \text{ksi} \\ V_{L2R} = & 308.89 & \text{kip} & (upward) & s_{A} = & 2.04 & \text{ksi} \\ H_{L2R} = & 343.21 & \text{kip} & (leftward) & Ratio = & 0.49 & - & OK \\ \hline \\ V_{total} = & 512.98 & \text{kip} & (upward) & s_{A} = & 5.11 & \text{ksi} \\ f_1 = & 5.48 & \text{kip/in} & (leftward) & s_{M} = & 7.31 & \text{ksi} \\ f_2 = & 2.18 & \text{kip/in} & (leftward) & s_{M} = & 2.04 & \text{ksi} \\ H_{cu} = & 68.95 & \text{kip} & (leftward) & s_{M} = & 2.20 & \text{ksi} \\ H_{cu} = & 68.95 & \text{kip} & (leftward) & Ratio = & 0.47 & - & OK \\ H_{bu} = & 182.84 & \text{kip} & (leftward) & Ratio = & 0.47 & - & OK \\ \hline \\ V_{bu} = & 71.94 & \text{kip} & (downward) & s_{A} = & 4.17 & \text{ksi} \\ \end{array}$	-					2	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$							rface — V total V Cc
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$				(downward)	• V ₁	FL	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	ooum		-	(uowiiwalu)			
$\begin{array}{c c c c c c c c c c c c c c c c c c c $							
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$\begin{array}{c ccccccccccccccccccccccccccccccccccc$							
Sway to the Right V_{U2R} = 226.61 kip (upward) $s_V = 11.46$ ksi H_{U2R} = 251.79 kip (rightward) $s_M = 7.31$ ksi V_{L2R} = 308.89 kip (upward) $s_A = 2.04$ ksi H_{L2R} = 343.21 kip (leftward) Ratio = 0.49 - OK V_{total} = 512.98 kip (upward) Ratio = 0.49 - OK V_{total} = 512.98 kip (upward) Ratio = 0.49 - OK V_{total} = 512.98 kip (upward) Ratio = 0.49 - OK V_{total} = 512.98 kip (upward) Ratio = 0.49 - OK V_{cu} = 154.67 kip (counter-clockwise) - Column-Side - V_{cu} = 154.67 kip (downward) s_A = 5.11 ksi - f_2 = 2.18 kip/in (leftward) s_M = 2.20 ksi - H_{cu} = 68.95 kip (leftward) Ratio = 0.47 - OK H_{bu} = 182.84 kip (leftward) <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>							
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$L_b \equiv$	23	1n		a Diaht		
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	V _{uon} –	226.61	kin			kei	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$							
							OK
$\begin{split} M &= 271.45 & \text{kip-ft} (\text{counter-clockwise}) \\ & Column-Side \\ V_{cu} &= 154.67 & \text{kip} (\text{downward}) & s_A &= 5.11 & \text{ksi} \\ f_1 &= 5.48 & \text{kip/in} (\text{leftward}) & s_V &= 11.46 & \text{ksi} \\ f_2 &= 2.18 & \text{kip/in} (\text{leftward}) & s_M &= 2.20 & \text{ksi} \\ H_{cu} &= 68.95 & \text{kip} (\text{leftward}) & \text{Ratio} &= 0.47 & - & \text{OK} \\ H_{bu} &= 182.84 & \text{kip} (\text{leftward}) & \text{Beam-Side} \\ V_{bu} &= 71.94 & \text{kip} (\text{downward}) & s_A &= 4.17 & \text{ksi} \end{split}$			_		Rutio = 0.17		ÖR
$\begin{array}{c cccc} Column-Side \\ V_{cu} = 154.67 & kip & (downward) & s_A = 5.11 & ksi \\ f_1 = 5.48 & kip/in & (leftward) & s_V = 11.46 & ksi \\ f_2 = 2.18 & kip/in & (leftward) & s_M = 2.20 & ksi \\ H_{cu} = 68.95 & kip & (leftward) & Ratio = 0.47 & - OK \\ H_{bu} = 182.84 & kip & (leftward) & Beam-Side \\ V_{bu} = 71.94 & kip & (downward) & s_A = 4.17 & ksi \\ \end{array}$							
	111 -	271110	mp it		Column-S	ide	
$f_2 = 2.18$ kip/in(leftward) $s_M = 2.20$ ksi $H_{cu} = 68.95$ kip(leftward)Ratio = 0.47-OK $H_{bu} = 182.84$ kip(leftward)Beam-SideOK $V_{bu} = 71.94$ kip(downward) $s_A = 4.17$ ksi	$V_{cu} =$	154.67	kip	(downward)	$s_A = 5.11$	ksi	
$H_{cu} = 68.95$ kip(leftward)Ratio = 0.47-OK $H_{bu} = 182.84$ kip(leftward)Beam-Side $V_{bu} = 71.94$ kip(downward) $s_A = 4.17$ ksi	$f_1 =$	5.48	kip/in	(lefttward)	$s_V = 11.46$	ksi	
$H_{bu} = 182.84$ kip (leftward)Beam-Side $V_{bu} = 71.94$ kip (downward) $s_A = 4.17$ ksi	f ₂ =	2.18	kip/in	(leftward)	s _M = 2.20	ksi	
$V_{bu} = 71.94$ kip (downward) $s_A = 4.17$ ksi	$H_{cu} =$	68.95	kip	(leftward)	Ratio = 0.47	-	OK
	H _{bu} =	182.84	kip	(leftward)	Beam-Sie	de	
$M_{cu} = 7.44$ kip-ft (counter-clockwise) $s_V = 10.60$ ksi	V _{bu} =	71.94	kip	(downward)	$s_A = 4.17$	ksi	
	$M_{cu} =$	7.44	kip-ft	(counter-clockwise)	$s_V = 10.60$	ksi	

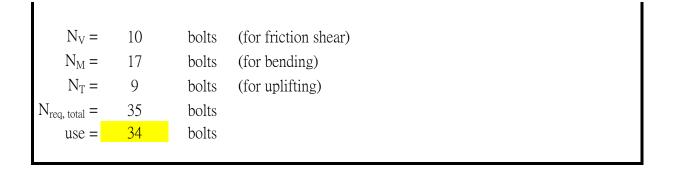
M _{bu} =	-118.93	kip-ft	(clockwise)	s _M = Ratio =	-21.58 0.56	ksi -	OK
$V_{cl} =$	154.67	kip	(downward)	$s_A =$	5.11	ksi	
$f_1 =$	5.48	kip/in	(rightward)	$s_V =$	11.46	ksi	
f ₃ =	2.18	kip/in	(rightward)	$s_M =$	2.20	ksi	
$H_{cl} =$	68.95	kip	(rightward)	Ratio =	0.47	-	OK
$H_{bl} =$	274.26	kip	(rightward)				
$V_{bl} =$	154.22	kip	(downward)	$s_A =$	8.94	ksi	
M_{bl} =	86.82	kip-ft	(clockwise)	$s_V =$	15.90	ksi	
$M_{cl} =$	7.44	kip-ft	(counter-clockwise)	$s_M =$	15.76	ksi	
				Ratio =	0.82	-	OK
$V_{mid} =$	156.39	kip	(downward)	$s_A =$	0.00	ksi	
$M_{mid} =$	10.02	kip-ft	(counter-clockwise)	$s_V =$	8.80	ksi	
$H_{mid} =$	0.00	kip	(leftward)	$s_M =$	1.71	ksi	
				Ratio =	0.34	-	OK
			Weld S	Size			
$f_v =$	8.59	kip/in					
$f_a =$	4.98	kip/in	(averaged)				
$f_b =$	5.48	kip/in					
$f_{peak} =$	13.54	kip/in					
$f_{avg} =$	11.07	kip/in					
$f_r =$	13.84	kip/in	13.84342				
D >=	4.97	x 1/16	(weld size)				
Use	6	x 1/16	(weld size)				

Title	TCBF-	B-1 Specin	men Design	Date	August 16, 2008		
1F	Ι	lower Bear	m to Gusset	Page	13		
Web	Fillet we	elds with w					
Flange		CJP weld		(T & B)			
$P_u =$	317.56	kip					
$t_f =$	0.59	in					
	8.97	in					
$A_s =$	5.25	in2					
$2*A_s*F_y =$	524.75	kip	OK				
$R_{beam} =$	22.51	kip	(Gravity)				
L _{tab} =	20.375	in		t =	0.5	in	
w _{tab} =	8	in					
Weld	Fillet	(she	ar tab)				
$F_{exx} =$	70	ksi		$R_n =$	315.96	kip	
$F_w =$	42	ksi		$\phi_{\rm b} =$	0.75	-	
w =	6	x 1/16	inch	$\phi_b R_n =$	236.97	kip	ОК
$L_{weld} =$	28.375	in					
	1	sides					
Shim Plate							
L =	20	in		t =	0.168	in	(shim as required)
W =	4	in	(1)				
Weld	Fillet		ar tab)	п	120.26	1_*	
$F_{exx} =$	70	ksi			139.26	kip	
$F_w =$	42	ksi			0.75	-	
w =	2.68	x 1/16	inch	$\phi_b R_n =$	104.45	kip	ОК
$L_{weld} =$	28	in	(3 sides)				
side =	1	sides					

Title	TCBI	F-B-1 Speci	men Design	Calculation	Sheet	Date	Augus	st 16, 2008
1F			Floor Beam (Page	0	14
Braces		HSS6x6x3						
T =	488.15	kip	$\sin(\theta) =$	0.669				
C =	461.74	kip	$\cos(\theta) =$	0.743				
e =	0	in		`×				\sim
Shear =	706.05	kip		(//)	\		<u> </u>	///
Tension =	242.31	kip		\rightarrow	$\langle \rangle$		\rightarrow	\langle
Moment =	0.00	kip-ft		$\langle \rangle$	$\langle \rangle$		Ľ.	γ
t _{gusset} =	0.75	in		. \	× `\		/~	
L =	46	in						
$s_V =$	20.47	ksi	$\mathbf{e} = 0.5 \; \mathbf{d}$	ון ו				Ļ
$s_M =$	0.00	ksi						
$\phi =$	0.9	-						
$F_{y, gusset} =$	50	ksi						
Ratio =	0.80	OK						
whitmo =	23.90	in	$L_{min} =$	35.72	in	(geometry	limit)	OK
$L_v =$	19	in	$L_{v, min} =$	17.76	in	(geometry	limit)	ОК
			, , , , , , , , , , , , , , , , , , , ,				·	
$w_{up} =$	11.95	in	$A_v =$	14.25	in2			
w _{low} =	14.12	in	$P_u =$	326.56	kip			
whit _{eff} =		in		384.75	kip			
	806.55	kip	OK		OK			
111	000.22	шp			011			
Weld	Fillet	(Guss	set to beam fl	lange)				
$F_{exx} =$	70	ksi						
$F_w =$	42	ksi						
w =	11	x 1/16	inch	$s_V =$	15.79	ksi		
$L_{weld} =$	46	in		$s_{M} =$		ksi		
side =	2	sides			5.42	ksi		
$t_{eff} =$	0.486	in		SA -	2.12	1201		
$t_{eff} = \phi =$	0.480	-						
φ = Ratio =	0.75	OK						
1.000 -	0.07							
			Che	ck Beam W	/eb			
width =	46	in			w30x391			
$R_u =$	0.00	kip	d =	33.2	in	$t_w =$	1.36	in
		-						

N =	23	in	$t_f =$	2.44	in	$F_{y, web} =$	50	ksi
φ =	0.75	-	$R_n =$	4450.60	kip	$\phi R_n =$	3337.95	kip
k _{des} =	3.23	in				(web cr	ippling)	OK
φ =	1.00	-	$R_n =$	2662.20	kip	$\phi R_n =$	2662.20	kip
						(web local	l yielding)	ОК
			Check Gu	usset Plate	Buckling			
L _{gb} =	14.84	in	kL/r =	82.2	-	$L_c =$	15.88	in
k =	1.2	-	$F_e =$	42.32	ksi	$L_{c1} =$	18.06	in
r =	0.217	in	$0.44 F_y =$	22	ksi	$L_{c2} =$	12.56	in
A _g =	17.92	in2	$R_n =$	546.54	kip	L _{max} =	18.56	in
φ =	0.9	-	$\phi R_n =$	491.88	kip	$L_{tip} =$	9.13	in
					OK	$L_{ave} =$	14.84	in
			Free	Edge Buc	kling			
$L_e =$	17.88	in						
$L_e/t_g =$	23.83	-						
Limit =	18.06	-	Edge stiffer	ner require	ed!			
			T., (). 1	Q ₄ ,1,11,4	(D			
ЪЛ	((15.02	1: 0		Stability c		т	10	C.
	6645.83	kip-ft	Z =		in3	$L_b =$	10	ft
a	1	-	-	30.76	in		17.05	ft
	51.85	kip		288.07	kip/in	n =		OK
(Nodal)			(Nodal)			$C_b =$	1	-
М —	70 75	1-:				τ_	1550	:
	79.75	kip-ft				$I_y =$	1550	in4
$P_{br} =$		kip	(torsional)					
	108666	kip-in/rad		included				
$\beta_{br} =$	114.85	kip/in	(torsional)					
$\Delta =$	0.27	in						

Title	TCBF-	B-1 Specin	men Design Calc	culation	Sheet	Date	August 16, 2008				
1F			ase Plate Design	Page	15						
Column		w12x96									
Z _x =	147	in3		L =	96.15	in					
$F_y =$	50	ksi		V _{Mp} =	152.89	kip					
M _p =	7350	kip-in									
$P_u =$	484.19	kip		d =	12.7	in					
$M_u =$	3290.12	kip-in		$b_f =$	12.2	in					
N =	31.25	in	fr	, _{max} =	36	ksi					
B =	28	in			1000						
e =	6.80	in		$q_{max} =$	1008	kip/in					
$e_{cr} =$	15.38	in	(Small Moment	t)							
Y =	17.66	in 1-i-r (i-r	OV								
q = m =	27.42 9.59	kip/in in	OK								
$f_p =$	0.98	ksi									
$t_{p, req} =$	2.01	in	eq 3.3.14a (LI	SED)							
use =	2.01	in		(1D)							
	2.00										
			All-thr	ead-rod	S						
Туре	ASTM A										
	1.125	in									
$F_u =$	125	ksi									
$F_y =$	105	ksi									
$F_{nt} =$	93.75	ksi									
$F_{nv} =$	50	ksi									
	0.99	in ²									
	0.75	-									
	69.89	kip	(tension)								
	37.28	kip	(shear)								
	86.98										
	152.89	kip (very conservative assumption)									
M _u =	7350	kip-in									
$P_u =$	600	kip	(very conservative assumption)								
μ =	0.35	- (class A surface)									
SF =	2	-	(safety factor fo	or not ha	aving enou	igh bolt pre	tension force)				



Title	TCBF-	B-1 Speci	men Design	Calculation	Sheet	Date	August 8, 2009
2F			Stub Beam		Page	16	
F1 =	300	kip		d =	24.3	in	
F2 =	600	kip		$t_w =$	0.55	in	
L _{stub} =	19	in		b =	12.8	in	
Beam	w242	x117		$t_f =$	0.85	in	
			Colum	n Dimensio	n List		
Column	w12						
$A_g =$	28.2	in^2		$b_f =$	12.2	in	
$I_x =$	833	in ⁴		$t_f =$	0.9	in	
$I_y =$	270	in ⁴		d =	12.7	in	
$r_x =$	5.44	in		$t_w =$	0.55	in	
$r_y =$	3.09	in		$F_y =$	50	ksi	
$k_{des} =$	1.5	in		$E_s =$	29000	ksi	
ļ			Column V	Web Local `	Yielding		
	24.00	in					
	866.25	kip					
	1.00	-					
$\phi R_n =$	866.25	kip	OK				
			Colum	n Woh Crir	nling		
P –	1382.366	kip	Coluin	n Web Crip	ping		
	0.75	кір					
-	1036.77	- kip	OK				
T T	1000.77	мр	OI				
			Column F	lange Local	Bending		
$R_n =$	253.13	kip	A _{web} =	12.43	in ²	$A_s =$	34.19 in ²
$\phi =$	0.90	-	$A_{flange} =$	21.76	in ²		
$\phi R_n =$	227.81	kip	F1 _{flange} =		kip		
		-	F2 _{flange} =		kip	Contin	ue Plate Required!
					-		
			Stub Bea	am Gross Y	ielding		
$A_{s (beam)} =$	34.4	in ²					
$P_y =$	1720	kip	OK				

Title	TCBF-	B-1 Speci	men Design	Calculation	Sheet	Date	August 8, 2009
1F		-	Stub Beam			Page	17
F ₁ =	300	kip		d =	23.7	in	
$F_2 =$	600	kip		$t_w =$	0.415	in	
L _{stub} =	19	in		b =	8.97	in	
Beam	w24	x68		$t_{f} =$	0.585	in	
			Colum	n Dimensio	n List		
Column	w12	x96					
A _g =	28.2	in ²		$b_f =$	12.2	in	
$I_x =$	833	in ⁴		$t_{\rm f}$ =	0.9	in	
$I_y =$	270	in ⁴		d =	12.7	in	
$r_x =$	5.44	in		$t_w =$	0.55	in	
$r_y =$	3.09	in		$F_y =$	50	ksi	
$k_{des} =$	1.5	in		$E_s =$	29000	ksi	
			Calum V		V: -1-1:		
N	24.00	in	Column V	Web Local `	rielding		
	866.25						
	1.00	kip -					
-	866.25	kip	OK				
' 11	000.20	mp	011				
			Colum	n Web Crip	pling		
$R_n =$	1382.366	kip					
$\phi =$	0.75	-					
$\phi R_n =$	1036.77	kip	OK				
			Column Fl	lange Local	Bending		
$R_n =$	253.13	kip	A _{web} =	9.35	in ²	Δ —	19.84 in ²
$A_n = \Phi$	0.90	мір	$A_{\text{web}} =$ $A_{\text{flange}} =$		in in ²	n_{s} –	
	227.81	- lzin	-				
$\phi R_n =$	227.01	kip	F1 _{flange} =		kip Irin		OV
			F2 _{flange} =	317.31	kip		ОК
			Stub Bea	am Gross Y	ielding		
$A_{s (beam)} =$	20.1	in ²					
P _y =	1005	kip	OK				

Title	TC	CBF-B-2 S	pecimen D	Design Calcu	ulation Sł	neet	Date May 27, 2009	
General							Page 1	
Buildin Typical floo $F_{1, max} =$ $F_{2, max} =$ SR =	300 600	2 9 kip kip -	stories ft			—F2·		
ratio =	0.8	-				L		
			C	Calculation I	nitialize			
Items	values	units		Items	values	units		
$F_1 =$	240	kip		$V_1 =$	720	kip		
$F_2 =$	480	kip		$V_2 =$	480	kip		
h ₁ =	9	ft						
h ₂ =	18	ft						
span =	20	ft	(beam spa	an)				
h =	9	ft	-	loor height)				
$M_{base} =$	13500	kip-ft						
$P_{column} =$	675	kip						
$L_{brace} =$	13.45	ft	(work poi	int to work j	point)			
E _s =	29000	ksi				Notes	: input value	
				Materia	ıls			
Members	Materia	al Type	Fy (ksi)	Fu (ksi)	Ry	Rt	(Ref: Table I-6-1)	
Columns	ASTM		50	65	1.1	1.1	4	
Beams	ASTM		50	65	1.1	1.1	_	
Braces	ASTM		42	58	1.4	1.3	(HSS-Round)	
Plates 1	ASTN		36	58	1.3	1.2	-	
Bolts Welds	A4 E70		130	150 70	-	-	-	
Plates 2	ASTM AST		50	65	-	1.2	-	
I TAICS Z	ADIMA.	12 01.30		Load Combi		1.2	1	
Per ASCE-7	-2005							
		a . t		sic Referen				
AISC Specif								
AISC Seism	AISC Seismic Provisions for Structural Steel Buildings (March 9, 2005)							

Title	TCBF	-B-2 Spec	cimen Design Calculation	n Sheet	Date	May 27, 2009
2F-Brace					Page	2
$P_u =$	144.00	kip	(compression)			
$L_{brace} =$	8.1	ft				
k =	1.0	-				
Try section	HSS5		(HSS-Square)	17.00	. 4	
	6.62	in^2		17.20	in ⁴	
	9.60	in ³	•	17.20	in ⁴	
OD =	5.00	in		5.00	in	
t _{nom} =	0.50	in	t _{des} =	0.465	in	
	1.61	in				
5	1.61	in				
F_y (brace) =	42	ksi	$E_s =$		ksi	
kL/r =	60.25	-		105.11	OK	$Kl/r \leq 4\sqrt{E/F_y}$
	78.85	ksi	$0.44 \mathrm{F_y} =$	18.48	ksi	
		-				
	200.23	kip	(compression)	Check	OK	
		actness S	eismically (AISC Seism			ec 8.2b)
$\lambda_{ps} =$	16.82	-	b/t =	0.00	OK	
			1.4	0.00	OW	(Table I-8-1)
			h/t =	0.00	OK	
φ =	0.90	-				
$\phi P_n =$	250.24	kip	(tension)	Check	OK	
• •		Ĩ				

Title	TCBF	-B-2 Spec	cimen Design (Calculation	Sheet	Date	May 27, 2009
1F-Brace						Page	3
$P_u =$	252.07	kip	(compression	n)			
$L_{brace} =$	9	ft					
k =	1.0	-	(1100 0	-)			
Try section			(HSS-Square		21.00	in 1	
	8.09	in2		$I_x =$		in4	
	14.30	in3			31.20	in4	
OD =		in in		OD =		in in	
$t_{nom} = r = r$		in in		u _{des} –	0.465	111	
	1.96	in					
5	1.96	in		P	20000	1 .	
F_y (brace) =	42	ksi			29000	ksi	$Kl/r \leq 4\sqrt{E/F_v}$
	55.10	- 1:		Limit = 0.44 E =		OK lasi	$\mathbf{K} l l r \leq 4 \mathbf{V} E / F_y$
	94.26 0.90	ksi		$0.44 F_{y} =$	18.48	ksi	
	253.77	- kip	(compression	n)	Check	OK	
			eismically (AI				ac 8.2b
	16.82	-		b/t =	0.00	OK	. 0.20)
ps =	10.02			0/1 -	0.00	OR	(Table I-8-1)
				h/t =	0.00	OK	(10010101)
$\phi =$	0.90	-					
$\phi P_n =$	305.80	kip	(tension)		Check	OK	

Title	TCBF	-B-2 Specin	men Design (Calculatio	n Sheet	Date	May 2	27, 2009
2F			lusset Plate C			Page		4
Brace		HSS5x.50	0					
$R_yF_yA_g =$	389.26	kip	(T_u)					
$F_uA_g =$	383.96	kip	(P_u)	$T_u/P_u =$	1.01	-		
$R_yF_y =$	58.8	ksi						
	75.4	ksi						
	0.9	-						
	0.75		apture in net s					
$A_n/A_g =$	1.16		ion reinforcen		ired!)			
$\phi_t =$	0.90		ield in gross s	section)	_			
t _{gusset} =	0.87	in	(estimated)		$F_y =$		ksi	
t _g =	0.75	in	(use)			(gusset		
					$F_u =$	65	ksi	
$A_{cut} =$	0.81	in ²						
	5.81	in ²						
$A_e =$	6.88	in ²	(Reinforcem	_				
				rcement l				
1 =	12	in	Section				F	
$x_{bar} = U =$	1.909859 0.84	in	$OD = A_{e, req} =$	6	in • 2	ID =	5 8.19	in in ²
	0.84 1.19	- in ²	$\Lambda_{e, req} =$ (both sides)	0.88	1n	$A_{net, req} =$	0.19	1n
$A_{reinf} = b_{reinf} =$	2.38	in in	$c_{reinf} =$	2 22	in			
	0.50	in		2.52	in in	L _{plate} =	14	in
-	42		$B_{use} = \frac{1}{R_y F_y A_g} = \frac{1}{R_y F_y A_g}$			L _{plate} –	14	in
$F_{y, plate} =$	42	ksi in	$R_y P_y A_g =$ weld =		kip x 1/16 in	(fillet)		
$L_{weld} = \phi R_n =$	83.51		OK	5	X 1/10 III	(IIIIel)		
$\psi \mathbf{x}_n -$	85.51	kip	ÛK					
			Brace	e Block S	hear			
t _{brace} =	0.465	in	21.00					
$L_{req} =$	8.02	in	OK					
$L_{use} =$	12	in						
		• 						
			Brace to (Gusset Pla	ate Weld			
$L_{weld} =$	12	in						
weld =	6	x 1/16 in	(fillet)					
$\phi_b =$	0.75	-						

$F_{exx} = F_{w} = \phi_{b}R_{n} =$	70 42 400.87	ksi ksi kip	OK	
			Gusset Plate Block Shear	
A _{gv} =	18	in ²		
$A_{nt} =$	4.31	in ²		
$U_{bs} =$	1	-		
φ =	0.75	-		
$\phi R_n =$	615.23	kip	OK	
			Whitmore Effective Width	
$L_{whitmore} =$	21.59	in	(theoretical width)	
φ =	0.90	-		
$\phi R_n =$	728.61	kip	OK (check gross yield)	

Title	TCBF	-B-2 Specin	men Design (Calculatio	n Sheet	Date	May 2	27, 2009
1F			Susset Plate C			Page		5
Brace		HSS6x.50	0					
$R_yF_yA_g =$	475.692	kip	(T_u)					
$F_uA_g =$	469.22	kip	(P_u)	$T_u/P_u =$	1.01	-		
$R_yF_y =$	58.8	ksi						
	75.4	ksi						
	0.9	-						
	0.75		upture in net s					
$A_n/A_g =$	1.16		ion reinforcen		ired!)			
$\phi_t =$	0.90		ield in gross s	section)				
t _{gusset} =	0.88	in	(estimated)		$F_y =$		ksi	
t _g =	0.75	in	(use)			(gusset		
					$F_u =$	65	ksi	
$A_{cut} =$	0.81	in ²						
	7.28	in ²						
$A_e =$	8.41	in ²	(reinforceme					
				orcement 2				
1 =	14	in	Section			ID	C	
x_bar = U =	2.23 0.84	in		7 8 4 1	in in ²	ID =	6 10.00	in in ²
	1.36	- in ²	$A_{e, req} =$ (both sides)	0.41	111	$A_{net, req} =$	10.00	1n
$A_{reinf} = b_{reinf} =$	2.73	in in	$c_{reinf} =$	266	in			
	0.50	in		2.00	in in	$L_{plate} =$	16	in
$t_{req} =$	42		$r_{use} = \frac{1}{R_y F_y A_g} =$			L _{plate} –	10	in
$F_{y, plate} =$	42 7	ksi in		5	kip x 1/16 in	(fillet)		
$L_{weld} = \phi R_n =$	97.43		OK	5	X 1/10 III	(IIIIel)		
$\psi \mathbf{x}_n -$	97.43	kip	ÛK					
			Brace	e Block S	hear			
t _{brace} =	0.465	in	21.00					
$L_{req} =$	9.80	in	OK					
$L_{use} =$	14	in						
								
			Brace to (Gusset Pl	ate Weld			
$L_{weld} =$	14	in						
weld =	7	x 1/16 in	(fillet)					
$\phi_{\rm b} =$	0.75	-						

	70 42 545.63	ksi ksi kip	OK
			Gusset Plate Block Shear
A _{gv} =	21	in^2	
$A_{nt} =$	5.16	in ²	
$U_{bs} =$	1	-	
φ =	0.75	-	
$\phi R_n =$	723.87	kip	OK
			Whitmore Effective Width
$L_{whitmore}$ =	24.90	in	(theoretical width)
$\phi =$	0.90	-	
$\phi R_n =$	840.30	kip	OK (check gross yield)

Title	TCBF	-B-2 Specin	nen Design Calculation	Date	May 2	7, 2009	
2F			eam Design Check		Page		5
$R_{y}F_{y}A_{g} = 0.3 P_{n} =$		kip kip	$\theta = \sin(\theta) = $	0.73 0.67	(rad)	42.0	(deg)
H = P _u =	215.75 338.94 600.00 88.57	kip kip kip kip-ft	cos(θ) = (conservatively) (revised from structura		,		
Try	w24	4x117					
$A_g =$	34.4	in ²	b _f =	12.8	in		
$I_x =$	3540	in ⁴	$t_{f} =$	0.85	in		
$I_y =$	297	in^4	d =	24.3	in		
$r_x =$	10.1	in	$t_w =$	0.55	in		
$r_y =$	2.94	in	$F_y =$	50	ksi		
$\lambda_{p1} =$	9.15		b/t =	7.53	Compact		
$\lambda_{p2} =$	90.55		h/tw =	41.09	Compact		
$L_p =$	10.38	ft		327	in ³		
c =	1	-	J =	6.72	in ⁴		
$C_w =$	40800	in ⁶	h _o =	23.45	in		
$S_x =$	291	in ³	$r_{ts} =$	3.46	in		
$L_r =$	29.90	ft	Brace PT=	2	-		
L _b =	10	ft	C _b =	1.0	(Conserv	vatively)	
$M_p =$	1362.5	kip-ft	$F_{cr} =$	248.50	ksi		
$\phi_{\rm b} =$	0.90	-	$M_n =$	1362.50	kip-ft	(Need	Check)
$\phi_b M_n =$	1226.25	kip-ft					
kl/r =	40.82	-	k =	1.0	-		
$F_e =$	171.79	ksi	$0.44 \mathrm{F_y} =$	22	ksi		
$\phi_{\rm c} =$	0.90	-					
$\phi_c P_n =$	1370.46	kip					
$P_u/\phi_c P_n =$ Check	0.44 0.50	use (H1-1a <mark>OK</mark>	a)				

Title	TCBF	F-B-2 Specin	nen Desigr	Calculation	Sheet	Date	May	27, 2009
1F		Lower E	Beam Design Check			Page		7
$R_yF_yA_g =$	475.69	kip	(1F)					
$R_yF_yA_g =$	389.26	kip	(2F)	θ =	0.73	(rad)	42.0	(deg)
$0.3 P_n =$	84.59	kip	(1F)	$\sin(\theta) =$	0.67			
$0.3 P_n =$	66.74	kip	(2F)	$\cos(\theta) =$	0.74			
	273.57	kip						
	303.97	kip						
	303.97	_	(conservat					
$M_u =$	159.45	kip-ft	(revised fr	om structura	l analysis))		
Т		1						
Try A _g =	w2 20.1	4x08 in ²		h. –	8.97	in		
_	1830	in ⁴		$b_{\rm f} = t_{\rm f} =$		in		
	70.4	in ⁴			23.7	in		
-						in		
	9.55	in in			0.415			
$r_y =$	1.87	111		Гу —	50	ksi		
$\lambda_{p1} =$	9.15			b/t =	7.67	Compact		
	90.55			h/tw =	54.29	Compact		
$L_p =$	6.61	ft		$Z_x =$	177	in ³		
c =	1	-		J =	1.87	in ⁴		
$C_w =$	9430	in ⁶		$h_o =$	23.12	in		
$S_x =$	154	in ³		$r_{ts} =$	2.30	in		
$L_r =$	18.74	ft		Brace PT=	2	-		
L _b =	10	ft		$C_b =$	1.0	(Conserv	vatively)	
$M_p =$	737.5	kip-ft		$F_{cr} =$	110.86	ksi		
$\phi_b =$	0.90	-		$M_n =$	656.87	kip-ft		OK
$\phi_b M_n =$	591.18	kip-ft						
	<i></i>							
	64.17	-			1.0	-		
	69.50	ksi		$0.44 F_{y} =$	22	ksi		
-	0.90	-						
$\Phi_c P_n =$	669.33	kip						
$P_u/\phi_c P_n =$ Check	0.45 0.69	use (H1-1a <mark>OK</mark>	1)					

Title	TCBF	-B-2 Specir	nen Design Calculation	Date	May 27, 2009	
2F			nn Design Check		Page	8
P _u = M _u =	43.94 110.65	kip kip-ft	(revised from structura (revised from structura			
$L_{column} =$	9	ft				
Try	w1	2x96				
$A_g =$	28.2	in^2	$b_{f} =$	12.2	in	
$I_x =$	833	in ⁴	$t_{f} =$	0.9	in	
$I_y =$	270	in^4	d =	12.7	in	
$r_x =$	5.44	in	$t_w =$	0.55	in	
$r_y =$	3.09	in	$F_y =$	50	ksi	
$\lambda_{p1} =$	7.22		b/t =	6.78	Compact	
$\lambda_{p1} = \lambda_{p2} =$	71.59	-	h/tw =	19.82	Compact	
$L_{p2} = L_p =$	10.91	- ft		19.82	in ³	
с =	10.91	-		6.85	in in ⁴	
$C = C_w =$	9410	in ⁶	$h_{o} =$	11.80	in	
$S_{\rm w} =$	131	in ³	$r_{ts} =$	3.49	in	
$L_r =$	40.86	ft		0	-	
$L_b =$	9	ft	$C_b =$		(Conserv	vatively)
M _p =	612.5	kip-ft	$F_{cr} =$		ksi	5,
$\phi_{b} =$	0.90	-		612.50		(Need Check)
		kip-ft	$C_a =$		-	
	34.95	-	k =	1.0	-	
	234.28	ksi	$0.44 F_{y} =$	22	ksi	
	0.90	-				
$\phi_c P_n =$	1160.56	kip				
$P_u/\phi_c P_n =$	0.04	use (H1-11	b)			
Check	0.22	OK	·			

Title	TCBF	-B-2 Specin	nen Design Calculation	Sheet	Date	May 27, 2009
1F			nn Design Check		Page	9
P _u = M _u =	493.82 263.05	_	(revised from structura (revised from structura			
L _{column} =	9	ft				
Try	w1	2x96				
$A_g =$	28.2	in ²	$b_f =$	12.2	in	
$I_x =$	833	in^4	$t_f =$	0.9	in	
$I_y =$	270	in^4	d =	12.7	in	
$r_x =$	5.44	in	$t_w =$	0.55	in	
$r_y =$	3.09	in	$F_y =$	50	ksi	
$\lambda_{p1} =$	7.22	-	b/t =	6.78	Compact	
$\lambda_{p2} =$	52.35	-	h/tw =	19.82	Compact	
$L_p =$	10.91	ft	$Z_x =$	147	in ³	
c =	1	-	J =	6.85	in ⁴	
$C_w =$	9410	in ⁶	$h_o =$	11.80	in	
$S_x =$	131	in ³	$r_{ts} =$	3.49	in	
$L_r =$	40.86	ft	Brace PT=	0	-	
$L_b =$	9	ft	$C_b =$	1.0	(Conserv	vatively)
M _p =	612.5	kip-ft	$F_{cr} =$	344.49	ksi	
$\phi_b =$	0.90	-	$M_n =$	612.50	kip-ft	(Need Check)
$\phi_b M_n =$	551.25	kip-ft	$C_a =$	0.39	-	
	34.95	-		1.0	-	
	234.28	ksi	$0.44 F_{y} =$	22	ksi	
	0.90	-				
$\phi_c P_n =$	1160.56	kip				
$P_u/\phi_c P_n =$	0.43	use (H1-1a	.)			
Check	0.85	OK				

Check Column Web Shear Stress									
$\begin{split} M_{p} &= 7350 \\ L &= 96.15 \\ V &= 152.89 \\ A_{s} &= 6.99 \\ S_{v} &= 21.89 \\ S_{v, \ yield} &= 29.00 \end{split}$	kip-in in kip in ² ksi ksi	$A_s = d*tw$ Elastic							

Title	TCBF	-B-2 Specin	men Design C	alculation	Sheet	Date	May 27, 2	2009
2F			Column Conne			Page	10	
Type H = V = M =	Bolted 169.47 107.88 88.57	(WUF-B) kip kip kip-ft	(revised from	n structura	ll analysis)	3		
$R_u =$	200.89	kip						=
Try d _b =	0.88	in	$F_u =$	150	ksi			
$A_b =$	0.60	in ²	$F_{nv} =$	75	ksi	(threads ex	cluded)	
N _b =	6	bolts	(in one row)					
$R_n =$	270.59	kip	(bolt shear)		$L_{c_{ex}} =$	1.5	in	
$\phi_b =$	0.75	-			$L_{c_in} =$	3	in	
$\phi_b R_n =$	202.94	kip	OK					
L _{c2} = t = R _n =	1.03 2.06 0.50 1227.66 0.75	in in in kip	(edge clear d (clear distanc (shear tab thi (combined be	ce) ickness)	$R_{n2} =$		kip kip	
	920.74	- kip	OK					
$L_{tab} =$	18	in	$A_{s, tab} =$	9	in ²	$R_n =$	524.79	kip
w _{tab} =		in		50		$P_{nt} =$		kip
			$F_{v, tab} =$	30.0	ksi	$P_{nv} =$	270.00 <mark>OK</mark>	kip
Weld	Fillet	(shea	ar tab)					
$F_{exx} =$	70	ksi			334.06	kip		
Fw =	42	ksi			0.75	-		
w =	5	x 1/16	inch	$\phi_b R_n =$	250.54	kip	OK	
L _{weld} = side =	18 2	in sides						
Weld	CJP	(top, botte	om flanges)					
b _f =	12.8	in		$F_{y, bm} =$	50	ksi	(base metal)	
$t_{\rm f}$ =	0.85	in		$M_n =$	1063.07	kip-ft	OK	
d =	24.3	in						
$t_w =$	0.55	in						

		Check Block Shear	r
		Check block Shear	
Beam			
w24x117			
$A_{gv} = 9.9$	in ²		
$A_{gt} = 1.925$	in ²		
$A_{nv} = 6.6$	in ²		
$A_{nt} = 1.65$	in ²		
$U_{bs} = 0.5$	-		
$\phi = 0.75$	-		
$F_y = 50$	ksi		
$F_u = 65$	ksi		
$\phi R_n = 233.27$	kip	OK	
Shear Tab	2		
$A_{gv} = 8.25$	in ²		
$A_{gt} = 1.5$	in ²		
$A_{nv} = 5.5$	in ²		
$A_{nt} = 1.25$	in^2		
$U_{bs} = 0.5$	-		
φ = 0.75	-		
$F_y = 50$	ksi		
$F_u = 65$	ksi		
$\phi R_n = 191.34$	kip	NG!	

Title	TCBF	-B-2 Speci	men Design (Calculation	Sheet	Date	May 27, 2009			
2F			to Beam Con			Page	11			
Braces		HSS5x.50	0							
T =	389.26	kip	$\sin(\theta) =$	0.669						
C =	342.61	kip	$\cos(\theta) =$	0.743						
e =	12.15	in								
Shear =	543.99	kip								
Tension =	197.89	kip								
Moment =	550.79	kip-ft	_7_			-	-7.			
$t_{gusset} =$	0.75	in	7	-	/L		e = 0.5 d			
L =	60	in					─ *			
$s_V =$	12.09	ksi	· /			ノヽ゚ヽヽ				
$s_A =$	4.40	ksi	ζ		\smile					
$s_M =$	14.69	ksi		X			\mathbf{X}			
φ =	0.9	-		/		_	\mathbf{i}			
$F_{y, gusset} =$	50	ksi	~				∽,			
Ratio =	0.63	OK								
$L_{whitmore} =$	21.59	in	$L_{min} =$	59.27	in	(geometry li	mit) OK			
$L_v =$	16	in	$L_{v, min} =$	16.05	in	(geometry li	mit) NG!			
w _{up} =	10.79	in	$A_v =$	12	in ²					
$w_{low} =$	20.92	in	$P_u =$	260.40	kip					
Whitm _{eff} =	21.59	in	♦R _n =	324	kip	OK				
$\phi R_n =$	728.61	kip	OK		_					
		1								
			Gusset Pl	ate to Bean	n Flange					
Weld	Fillet									
$F_{exx} =$	70	ksi								
$F_w =$	42	ksi		$s_V =$	12.82	ksi				
w =	8	x 1/16	inch	$s_M =$	15.58	ksi				
$L_{weld} =$	60	in			4.67	ksi				
side =	2	sides			23.97	ksi				
t _{eff} =	0.354	in		-	20.40	ksi				
$\phi =$	0.75	-			25.50	ksi				
φ = Ratio =	0.86	OK		Ratio =	0.81	OK				
1000-	0.00			1.uuo –	0.01					
	Check Beam Web									
width =	60	in	Beam		w24x117	1				

R., =	220.32	kip	d =	24.3	in	t _w =	0.55	in		
N =	30	in		0.85	in	$F_{y, web} =$		ksi		
$\phi =$	0.75	-		1060.63	kip	-	795.47	kip		
	1.35	in	11	1000.02	мр	(web crij		OK		
$\phi =$	1.00	-	R., =	1010.63	kip		1010.63	kip		
Υ	1.00		11	1010.02	мр	(web local		OK		
			Check Gu	isset Plate	Buckling	`	<i>.</i>			
L _{gb} =	17.68	in	kL/r =	98.0	-	$L_c =$	14.13	in		
k =	1.2	-	$F_e =$	29.82	ksi	$L_{c1} =$	11.38	in		
r =	0.217	in	$0.44 F_y =$	22	ksi	$L_{c2} =$	16.94	in		
A _g =	16.19	in^2	$R_n =$	401.31	kip	$L_{max} =$	24.06	in		
φ =	0.9	-	$\phi R_n =$	361.18	kip	$L_{tip} =$	21.88	in		
		-			OK	$L_{ave} =$	17.68	in		
			Free	Edge Buck	kling					
$L_e =$	15.63	in								
$L_e/t_g =$	20.83	-								
Limit =	18.06	-	Edge stiffer	ner require	d!					
L										
	1400 75	1-1		Stability o		T _	10	C.		
	1498.75	kip-ft	Z =		in ³	$L_b =$	10	ft A		
-	1	-		23.45	in 1-in/in		17.05	ft		
	15.34	kip	$\beta_{br} =$	85.22	kip/in		1	OK		
(Nodal)			(Nodal)			$C_b =$	1	-		
$M_{\rm br} =$	17.985	kip-ft								
$P_{br} =$	9.20	kip	(torsional)							
			β_{sec} not i	ncluded						
_			(torsional)							
	0.18	in	, a a <u></u> /							
				Kicker						
L3x2		C								
$A_g =$	1.73	in ²								
L =	25 2006 8	in Irin/in								
k _{axial} = k =	2006.8 1419	kip/in kip/in	OK							
к =	1417	ктр/ш	ЛU							

Title	Т	CBF-B-2	Specimen Design Calc	ulation Sheet	Date	May 27, 2009
1F		Beam	-Column-Gusset Conn	ections	Page	12
	Bi	g Gusset I	Plate for Upper Floor B	racing and Lower Floo	or Bracing	
Sv	vay to Rigl	ht		V _U	\mathbf{F}_{U}	
$F_{U2R} =$	389.26	kip	$\cos(\theta_{\rm U}) = 0.743$		► H _U	
$F_{L2R} =$	434.24	kip	$\cos(\theta_{\rm L}) = 0.743$		110	
	way to Lef	Ìt				- 0.5 (H _U +H _L)
$F_{U2L} =$	342.61	kip		W.P. Minterface	im	$-0.3 (H_{\rm U}+H_{\rm L})$
	475.69	kip		W.B	ź	
	w24			V _{total}		05(11,11)
_	23.7	in				$- 0.5 (H_U + H_L)$
$L_{c, \min} =$		in				$V_{total} = V_U - V_L - R_{beam}$ $V_{face} = V_{total} \cdot e_c$
Column	w12				<u>`</u>	$face - V total + C_c$
$e_c =$	6.35 21.32	in Icin	(downword)	• V _L	FL	
ooum	21.52 16.66	kip in	(downward)			
$L_{b, \min} =$		in				
$L_{cu, min} =$	16.05	in				
$L_{cl, min} =$	18.51	in				
$t_g =$	0.75	in				
$L_{cu} =$	18	in	(use) $F_{y, gusset} =$	50 ksi		
$L_{cl} =$	18	in	(use)			
$L_c =$	59.7	in	(use)			
L _b =	23	in	(use)			
			Sway to th			
$V_{U2R} =$		kip	(upward)	$s_V = 11.83$	ksi	
$H_{U2R} =$		kip	(rightward)	$s_{\rm M} = -7.55$	ksi	
	290.49	kip	(upward)	$s_A = 0.75$	ksi	
$H_{L2R} =$		kip	(leftward)	Ratio = 0.49	-	OK
$V_{total} =$		kip	(upward)			
M =	280.23	kip-ft	(counter-clockwise)			
N 7	150 (7	1 •	(11)	Column-Sic		
	159.67	kip	(downward)	$s_A = 5.27$	ksi	
	5.66	kip/in	(lefttward)	$s_V = 11.83$	ksi	
$f_2 =$		kip/in	(leftward)	$s_{\rm M} = 2.28$	ksi	<u></u>
$H_{cu} =$		kip	(leftward)	Ratio = 0.49	-	OK
	218.16	kip	(leftward)	Beam-Side		
	100.73	kip	(downward)	$s_A = 5.84$	ksi	
$M_{cu} =$	7.68	kip-ft	(counter-clockwise)	$s_V = 12.65$	ksi	

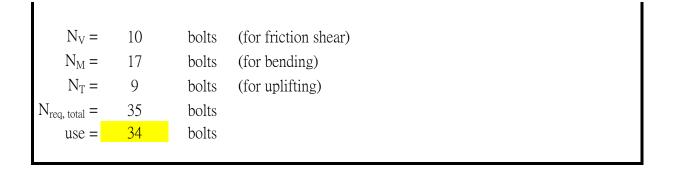
M _{bu} =	-112.45	kip-ft	(clockwise)	s _M = Ratio =	-20.41 0.58	ksi -	OK
$V_{cl} =$	159.67	kip	(downward)	$s_A =$	5.27	ksi	
$f_1 =$	5.66	kip/in	(rightward)	$s_V =$	11.83	ksi	
$f_3 =$	2.25	kip/in	(rightward)	$s_M =$	2.28	ksi	
$H_{cl} =$	71.18	kip	(rightward)	Ratio =	0.49	-	OK
$H_{bl} =$	251.59	kip	(rightward)				
$V_{bl} =$	130.82	kip	(downward)	$s_A =$	7.58	ksi	
$M_{bl} =$	100.71	kip-ft	(clockwise)	$s_V =$	14.58	ksi	
$M_{cl} =$	7.68	kip-ft	(counter-clockwise)	$s_M =$	18.28	ksi	
				Ratio =	0.80	-	OK
$V_{mid} =$	161.44	kip	(downward)	$s_A =$	0.00	ksi	
$M_{mid} =$	10.34	kip-ft	(counter-clockwise)	$s_V =$	9.08	ksi	
$H_{mid} =$	0.00	kip	(leftward)	$s_M =$	1.77	ksi	
				Ratio =	0.35	-	OK
			Weld S	lize			
$f_v =$	8.87	kip/in					
$f_a =$	5.13	kip/in	(averaged)				
$f_b =$	5.66	kip/in					
$f_{peak} =$	13.97	kip/in					
$f_{avg} =$	11.43	kip/in					
$f_r =$	14.28	kip/in	14.283				
D >=	5.13	x 1/16	(weld size)				
Use	6	x 1/16	(weld size)				

Title	TCBF-	B-2 Specin	men Design	Calculation	Sheet	Date	May 27, 2009
1F	Ι	lower Bear	m to Gusset	Plate Splice		Page	13
Web	Fillet we	elds with w					
Flange		CJP weld		(T & B)			
$P_u =$	303.97	kip					
$t_{f} =$	0.59	in					
	8.97	in					
$A_s =$	5.25	in2					
$2*A_s*F_y =$	524.75	kip	OK				
$R_{beam} =$	21.32	kip	(Gravity)				
L _{tab} =	20.375	in		t =	0.5	in	
w _{tab} =	8	in					
Weld	Fillet	(she	ar tab)				
$F_{exx} =$	70	ksi		$R_n =$	315.96	kip	
$F_w =$	42	ksi		$\phi_{\rm b} =$	0.75	-	
w =	6	x 1/16	inch	$\phi_b R_n =$	236.97	kip	OK
$L_{weld} =$	28.375	in					
side =	1	sides					
Shim Plate							
L =	20	in		t =	0.168	in	(shim as required)
W =	4 Eillet	in (aba	or tob)				
Weld E –	Fillet		ar tab)	D _	130.26	lzin	
$F_{exx} =$	70	ksi			139.26	kip	
$F_w =$	42	ksi			0.75	-	OV
w =	2.68	x 1/16	inch	$\phi_b R_n =$	104.45	kip	OK
$L_{weld} =$	28	in	(3 sides)				
side =	1	sides					

Title	TCBF	-B-2 Speci	men Design	Calculation	Sheet	Date	May 2	27, 2009
1F			Floor Beam (Page		14
Braces		HSS6x.50	0					
T =	475.69	kip	$\sin(\theta) =$	0.669				
C =	434.24	kip	$\cos(\theta) =$	0.743				
e =	0	in		Σ.				\sim
Shear =	676.34	kip			~—			//
Tension $=$	239.00	kip		\rightarrow	$\langle \rangle$		\sim \sim	
Moment =	0.00	kip-ft		$\langle \rangle$	$\langle \rangle$	\frown	<u> </u>)
t _{gusset} =	0.75	in		\	× `\		/	/ .
L =	46	in						
$s_V =$	19.60	ksi	$\mathbf{e} = 0.5 \; \mathbf{d}$	I L L	-	L'	F	Ļ
$s_M =$	0.00	ksi		-'				- <u>/</u> -
$\phi =$	0.9	-						
$F_{y, gusset} =$	50	ksi						
Ratio =	0.77	OK						
whitmo =	24.90	in	$L_{min} =$	37.22	in	(geometry	limit)	ОК
$L_v =$	19	in	$L_{v, min} =$	18.51	in	(geometry	limit)	ОК
			,					
$w_{up} =$	12.45	in	$A_v =$	14.25	in2			
$w_{low} =$	14.12	in	$P_u =$	318.22	kip			
whit _{eff} =		in	$\phi R_n =$	384.75	kip			
	840.30	kip	OK		OK			
111	010100	mp	011		011			
Weld	Fillet	(Guss	set to beam f	lange)				
$F_{exx} =$	70	ksi						
$F_w =$	42	ksi						
	11	x 1/16	inch	$s_V =$	15.12	ksi		
$L_{weld} =$	46	in		$s_{M} =$		ksi		
$E_{weld} =$ side =	2	sides			5.34	ksi		
				s _A –	5.54	<u>к</u> 91		
$t_{eff} =$	0.486	in						
$\phi =$	0.75	<u> </u>						
Ratio =	0.85	OK						
┣────			Che	ck Beam W	/eb			
width =	46	in	Beam		w30x391			
$R_u =$	0.00	kip	d =		in	t _w =	1.36	in
- `u	0.00	мp	u –	55.0	111	•w	1.50	111

N =	23	in	$t_f =$	2.44	in	$F_{y, web} =$	50	ksi			
φ =	0.75	-	$R_n =$	4450.60	kip	$\phi R_n =$	3337.95	kip			
k _{des} =	3.23	in				(web cr	ippling)	OK			
φ =	1.00	-	$R_n =$	2662.20	kip	$\phi R_n =$	2662.20	kip			
						(web local	l yielding)	OK			
Check Gusset Plate Buckling											
L _{gb} =	14.84	in	kL/r =	82.2	-	$L_c =$	15.88	in			
k =	1.2	-	$F_e =$	42.32	ksi	$L_{c1} =$	18.06	in			
r =	0.217	in	$0.44 F_y =$	22	ksi	$L_{c2} =$	12.56	in			
A _g =	18.67	in2	$R_n =$	569.41	kip	L _{max} =	18.56	in			
φ =	0.9	-	$\phi R_n =$	512.47	kip	L _{tip} =	9.13	in			
					OK	$L_{ave} =$	14.84	in			
			Free	Edge Buc	kling						
$L_e =$	17.88	in									
$L_e/t_g =$	23.83	-									
Limit =	18.06	-	Edge stiffer	ner require	ed!						
			T., (). 1	Q ₄ ,1,11,4	(D						
ЪЛ	((15.02	1: 0		Stability c		т	10	C.			
	6645.83	kip-ft	Z =		in3	$L_b =$	10	ft			
a	1	-	-	30.76	in		17.05	ft			
	51.85	kip		288.07	kip/in	n =		OK			
(Nodal)			(Nodal)			$C_b =$	1	-			
М —	70 75	1-:				т_	1550	:			
	79.75	kip-ft				$I_y =$	1550	in4			
$P_{br} =$		kip	(torsional)								
	108666	kip-in/rad		included							
$\beta_{br} =$	114.85	kip/in	(torsional)								
$\Delta =$	0.27	in									

Title	TCBF-	B-2 Speci	men Design	Calculation	Sheet	Date	May 27, 2009
1F			ase Plate De			Page	15
Column		w12x96					
$Z_x =$	147	in3		L =	96.15	in	
$F_y =$	50	ksi		$V_{Mp} =$	152.89	kip	
$M_p =$	7350	kip-in					
_							
	493.82	kip		d =		in	
$M_u =$	3156.6	kip-in		$b_f =$	12.2	in	
N	21.05			c	26	, .	
N =	31.25	in		f _{p, max} =	36	ksi	
B =	28 6 20	in		a –	1009	1 rin lin	
e =	6.39 15 29	in in	(Small M-	$q_{max} =$	1008	kip/in	
e _{cr} = Y =	15.38 18.47	in in	(Small Mor	nent)			
1 = q =	18.47 26.74	in kip/in	OK				
q = m =	9.59	in	OR				
$f_p =$	0.96	ksi					
$t_{p, req} =$	1.99	in	eq 3.3.14a	(LRFD)			
use =	2.00	in					
			Al	l-thread-rod	S		
Туре	ASTM A	4193 B7					
	1.125	in					
$F_u =$	125	ksi					
$F_y =$	105	ksi					
$F_{nt} =$	93.75	ksi					
$F_{nv} =$	50	ksi					
	0.99	in ²					
	0.75	-					
	69.89	kip	(tension)				
$\phi R_n =$	37.28	kip	(shear)				
$F_{PT} =$	86.98	kip	(minimum	required pre	etension)		
$V_u =$	152.89	kip	(very conse	ervative assu	umption)		
$M_u =$	7350	kip-in	(very conse	ervative assu	umption)		
$P_u =$	600	kip	(very conse	ervative assu	umption)		
μ=	0.35	-	(class A su	rface)			
SF =	2	-	(safety fact	or for not h	aving enou	ugh bolt pre	tension force)



Title	TCBF-	B-2 Speci	men Design	Calculation	Sheet	Date	May 27, 2009
2F			Stub Beam			Page	16
F1 =	300	kip		d =	24.3	in	
F2 =	600	kip		$t_w =$	0.55	in	
L _{stub} =	19	in		b =	12.8	in	
Beam	w242	x117		$t_f =$	0.85	in	
			Colum	n Dimensio	n List		
Column	w12	2x96					
$A_g =$	28.2	in ²		$b_f =$	12.2	in	
$I_x =$	833	in ⁴		$t_f =$	0.9	in	
$I_y =$	270	in ⁴		d =	12.7	in	
$r_x =$	5.44	in		$t_w =$	0.55	in	
r _y =	3.09	in		$F_y =$	50	ksi	
k _{des} =	1.5	in		$E_s =$	29000	ksi	
			Column V	Web Local `	Yielding		
	24.00	in					
	866.25	kip					
	1.00	-					
$\phi R_n =$	866.25	kip	OK				
			Colum	n Woh Crir	nling		
R –	1382.366	kip	Coluin	n Web Crip	pnng		
	0.75	кір					
	1036.77	kip	OK				
1 11	1020.77	мр	OII				
			Column F	lange Local	Bending		
$R_n =$	253.13	kip	$A_{web} =$	12.43	in ²	$A_s =$	34.19 in ²
$\phi =$	0.90	-	$A_{flange} =$	21.76	in ²		
$\phi R_n =$	227.81	kip	F1 _{flange} =		kip		
		_	F2 _{flange} =		kip	Contin	ue Plate Required!
			2		_		
			Stub Bea	am Gross Y	ielding		
$A_{s (beam)} =$	34.4	in ²					
$P_y =$	1720	kip	OK				

Title	TCBF-	B-2 Speci	men Design	Calculation	Sheet	Date	May 27,	2009		
1F			Stub Beam			Page	17			
$F_1 =$	300	kip		d =	23.7	in				
$F_2 =$	600	kip		$t_w =$	0.415	in				
L _{stub} =	19	in		b =	8.97	in				
Beam	w24	x68		$t_f =$	0.585	in				
			Colum	n Dimensio	n List					
Column	w12									
$A_g =$	28.2	in ²		$b_f =$	12.2	in				
$I_x =$	833	in ⁴		$t_f =$	0.9	in				
$I_y =$	270	in ⁴		d =	12.7	in				
$r_x =$	5.44	in		$t_w =$	0.55	in				
$r_y =$	3.09	in		$F_y =$	50	ksi				
$k_{des} =$	1.5	in		$E_s =$	29000	ksi				
			Column V	Web Local `	Yielding					
N =	24.00	in								
$R_n =$	866.25	kip								
φ =	1.00	-								
$\phi R_n =$	866.25	kip	OK							
			Colum	n Web Crip	pling					
$R_n =$	1382.366	kip								
φ =	0.75	-								
$\phi R_n =$	1036.77	kip	OK							
			Column F	lange Local	Bending					
$R_n =$	253.13	kip	$A_{web} =$	9.35	in^2	$A_s =$	19.84	in^2		
φ =	0.90	-	$A_{flange} =$	10.49	in^2					
$\phi R_n =$	227.81	kip	F1 _{flange} =	158.65	kip					
			F2 _{flange} =	317.31	kip		OK			
	Stub Beam Gross Yielding									
$A_{s (beam)} =$	20.1	in^2								
$P_y =$	1005	kip	OK							
3										

Title	TC	CBF-B-3 S	pecimen I	Design Calcu	lation Sł	neet	Date May 28, 2009	
General							Page 1	
Buildir Typical floo $F_{1, max} =$ $F_{2, max} =$ SR =	300 600	2 9 kip kip -	stories ft			—F2·		
ratio =	0.8	-						
			C	Calculation In				
Items	values	units		Items	values	units		
$F_1 =$	240	kip		$V_1 =$	720	kip		
$F_2 =$	480	kip		$V_2 =$	480	kip		
$h_1 =$	9	ft						
h ₂ =	18	ft						
span =	20	ft	(beam spa	an)				
h =	9	ft	(typical f	loor height)				
$M_{base} =$	13500	kip-ft						
$P_{column} =$	675	kip						
$L_{brace} =$	13.45	ft	(work po	int to work p	point)			
E _s =	29000	ksi				Notes	: input value	
				Materia	ls			
Members	Materia	al Type	Fy (ksi)	Fu (ksi)	Ry	Rt	(Ref: Table I-6-1)	
Columns	ASTM		50	65	1.1	1.1	4	
Beams	ASTM		50	65	1.1	1.1	4	
Braces	ASTM		50	65	1.1	1.1	(Wide Flange)	
Plates 1	ASTN		36	58	1.3	1.2	4	
Bolts	A4		130	150	-	-	4	
Welds	E70		-	70	-	- 1.0	-	
Plates 2	ASTM AS	072 Gr.30	50	65	1.1	1.2		
Per ASCE-7	2005		1	Load Combi	nations			
I U ASCE-/	-2003							
			Rs	asic Reference	re Codes			
AISC Specification for Structural Steel Buildings (March 9, 2005)								
AISC Specif	ication for S	Structural	Steel Build	dings (March	19,2005	()		

Title	TCBF	-B-3 Spec	cimen Design Calculatior	Sheet	Date	May 28, 2009
2F-Brace					Page	2
$P_u =$	139.67	kin	(compression)			
$L_{brace} =$	8.1	ft	(compression)			
	1.0	-				
Try section		x21	(HSS-Square)			
	6.16	in ²		75.30	in^4	
	20.40	in ³		75.30	in^4	
$b_{f} =$		in		0.40	in	
d =	8.28	in		0.250	in	
$r_x =$	3.49	in				
	1.26	in				
F_v (brace) =	50	ksi	$E_s =$	29000	ksi	
5	76.98	-		96.33	OK	$Kl/r \leq 4\sqrt{E/F_v}$
$F_e =$	48.29	ksi	$0.44 F_{y} =$	22	ksi	
$\phi =$	0.90	-				
$\phi P_n =$	179.72	kip	(compression)	Check	OK	
		oactness S	eismically (AISC Seismi	c Provision	ns 2005, Se	ec 8.2b)
	7.22	-	$b_{\rm f} / 2t =$	6.59	OK	
	0.50					(Table I-8-1)
$\lambda_{ps} =$	35.88	-	$h / t_w =$	27.50	OK	
φ =	0.90	-				
	277.20	kip	(tension)	Check	OK	
• 11	_,,,_,	mp	(********)	0	011	

Title	TCBF	-B-3 Spec	cimen Design Calculation	n Sheet	Date	May 28, 2009
1F-Brace					Page	3
$P_u =$	254.24	kip	(compression)			
$L_{brace} =$		ft	(••••••••••			
	1.0	-				
Try section		x28	(HSS-Square)			
	8.24	in2	$I_x =$	98.00	in4	
$Z_x =$	27.20	in3	$I_y =$	98.00	in4	
b =	6.54	in	$t_{f} =$	0.47	in	
d =		in		0.285	in	
$r_x =$	3.45	in				
	1.62	in				
F_v (brace) =	50	ksi	$E_s =$	29000	ksi	
5	66.67	-		96.33	ОК	$Kl/r \leq 4\sqrt{E/F_{y}}$
$F_e =$	64.40	ksi	$0.44 F_{y} =$	22	ksi	
$\phi =$	0.90	-				
$\phi P_n =$	267.92	kip	(compression)	Check	OK	
С	heck Comp	oactness S	eismically (AISC Seismi	c Provision	ns 2005, Se	ec 8.2b)
$\lambda_{ps} =$	7.22	-	$b_{\rm f} / 2t =$	7.03	OK	
	0.69					(Table I-8-1)
$\lambda_{ m ps} =$	35.88	-	$h / t_w =$	22.30	OK	
φ =	0.90					
		- kin	(tension)	Check	OK	
Ψι η -	570.00	ктр	(101151011)	CHUCK	OK	

Title	TCBF	-B-3 Specin	men Design (Calculatio	n Sheet	Date	May	28, 2009
2F			Gusset Plate C			Page		4
Brace		W8x21						
$R_yF_yA_g =$	338.80	kip	(T _u)					
$F_uA_g =$	400.40	kip	(P_u)	$T_u/P_u =$	0.85	-		
$R_yF_y =$	55	ksi						
	71.5	ksi						
	0.9	-						
	0.75		apture in net s					
$A_n/A_g =$	1.14		ion reinforcer		red!)			
$\phi_t =$	0.90	(tensile y	ield in gross s	section)				
$t_{gusset} =$	0.71	in	(estimated)		$F_y =$		ksi	
t _g =	0.75	in	(use)			(gusset	plate)	
					$F_u =$	65	ksi	
$A_{cut} =$	2.57	in^2						
$A_{net} =$	3.59	in^2						
A _e =	6.32	in ²	(Reinforcem	nent requir	red!)			
				orcement l	Plates			
1 =	12	in	d =	8.28	in			
U =	1.00		$A_{e, req} =$	632	:2	A _{net, req} =	6.32	in^2
$A_{reinf} =$	1.36	- in ²	(both sides) $(1 \text{ k}_{e, \text{ req}} = 1 \text{ k}_{e, \text{ req}} = 1 \text{ k}_{e, \text{ req}}$	0.52	111	net, req –	0.52	111
	4	in	(00011 31003)					
$t_{req} =$	0.47	in	t _{use} =	0.5	in	L _{plate} =	1/	in
$F_{y, plate} =$	36	ksi	$R_y F_y A_g =$		kip	Dplate –	14	111
$L_{weld} =$	6	in	weld =		x 1/16 in	(fillet)		
-	100.22	kip	OK	0	A 1/10 III	(IIIICI)		
Ψι τ _n –	100.22	мр	OK					
			Brace	e Block S	hear			
t _{brace} =	0.4	in						
$L_{req} =$	7.24	in	OK					
$L_{use} =$	12	in						
			Brace to (Gusset Pla	ate Weld			
$L_{weld} =$	12	in						
weld =	6	x 1/16 in	(fillet)					
$\phi_{b} =$	0.75	-						

$F_w =$	70 42 400.87	ksi ksi kip	ОК	
			Gusset Plate Block Shear	
A _{gv} =	18	in ²		
_		in^2		
	6.77			
	1	-		
$\phi =$	0.75	-		
$\phi R_n =$	735.16	kip	OK	
			Whitmore Effective Width	
$L_{whitmore} =$	23.87	in	(theoretical width)	
	0.90	-		
$\phi R_n =$	805.56	kip	OK (check gross yield)	
-		-		
			Brace Web Block Shear	
$A_{gv} =$	3	in^2		
_	1.19	in ²		
	1.17	-		
	0.75	-		
$\phi R_n =$	125.39	kip	OK	

Title	TCBF	-B-3 Specin	men Design (Calculatio	n Sheet	Date	May	28, 2009
1F			Susset Plate C			Page		5
Brace		W8x28						
$R_yF_yA_g =$	453.2	kip	(T_u)					
$F_uA_g =$	535.6	kip	(P_u)	$T_u/P_u =$	0.85	-		
$R_yF_y =$	55	ksi						
	71.5	ksi						
	0.9	-						
	0.75		upture in net s					
$A_n/A_g =$	1.14		ion reinforcer		ired!)			
$\phi_t =$	0.90		ield in gross s	section)	_			
$t_{gusset} =$	0.77	in	(estimated)		$F_y =$		ksi	
t _g =	0.75	in	(use)			(gusset		
					$F_u =$	65	ksi	
$A_{cut} =$	2.85	in ²						
$A_{net} =$		in ²						
A _e =	8.45	in ²	(reinforceme					
				prcement]				
1 =	14	in	d =	8.06	in			
U =	1.00		$A_{e, req} =$	8 1 5	in^2	A _{net, req} =	8 1 5	in ²
$A_{reinf} =$	1.53	- in ²	(both sides)	0.75	111	¹ net, req —	0.45	111
$b_{reinf} =$	4	in	(0001 51005)					
$t_{req} =$	0.53	in	t _{use} =	0.625	in	L _{plate} =	16	in
$F_{y, plate} =$	36	ksi	$R_yF_yA_g =$		kip	Dplate –	10	111
$L_{weld} =$	50 7	in		6	x 1/16 in	(fillet)		
$\phi R_n =$, 116.92	kip	OK	0	A 1/10 III			
Ψι (η -	110.72	кıр	OIX					
			Brace	e Block S	hear			
t _{brace} =	0.465	in						
$L_{req} =$	8.33	in	OK					
$L_{use} =$	14	in						
		-						
			Brace to (Gusset Pla	ate Weld			
$L_{weld} =$	14	in						
weld =	7	x 1/16 in	(fillet)					
$\phi_{\rm b} =$	0.75	-						

$F_w =$	70 42 545.63	ksi ksi kip	ОК	
			Gusset Plate Block Shear	
$A_{gv} =$	21	in ²		
$A_{nt} =$	6.70	in ²		
$U_{bs} =$	1	-		
φ =	0.75	-		
$\phi R_n =$	799.19	kip	OK	
			Whitmore Effective Width	
$L_{whitmore} =$	25.96	in	(theoretical width)	
	0.90	-		
$\phi R_n =$	876.08	kip	OK (check gross yield)	
			Brace Web Block Shear	
$A_{gv} =$	3.99	in ²		
$A_{nt} =$	1.35	in ²		
$U_{bs} =$	1	-		
$\phi =$	0.75	-		
$\phi R_n =$	155.77	kip	OK	

Title	TCBF	-B-3 Specin	nen Design Calculation	Sheet	Date	May 28	8, 2009
2F			eam Design Check		Page		<u>.</u>
$R_{y}F_{y}A_{g} = 0.3 P_{n} =$		kip kip	$\theta = \sin(\theta) = 0$	0.73 0.67	(rad)	42.0	(deg)
	186.57 296.36 600.00 92.46	kip kip kip kip-ft	cos(θ) = (conservatively) (revised from structura				
Try	w24	4x117					
$A_g =$	34.4	in ²	b _f =	12.8	in		
$I_x =$	3540	in^4	$t_{f} =$	0.85	in		
$I_y =$	297	in^4	d =	24.3	in		
$r_x =$	10.1	in	$t_w =$	0.55	in		
r _y =	2.94	in	$F_y =$	50	ksi		
$\lambda_{p1} =$	9.15		b/t =	7.53	Compact		
$\lambda_{p2} =$	90.55		h/tw =	41.09	Compact		
$L_p =$	10.38	ft	$Z_x =$	327	in ³		
c =	1	-	J =	6.72	in ⁴		
C _w =	40800	in ⁶	h _o =	23.45	in		
$S_x =$	291	in ³	$r_{ts} =$	3.46	in		
$L_r =$	29.90	ft	Brace PT=	2	-		
$L_b =$	10	ft	C _b =	1.0	(Conserv	vatively)	
$M_p =$	1362.5	kip-ft	$F_{cr} =$	248.50	ksi		
$\phi_{\rm b} =$	0.90	-	$M_n =$	1362.50	kip-ft	(Need	Check)
$\phi_b M_n =$	1226.25	kip-ft					
kl/r =	40.82	-	k =	1.0	-		
$F_e =$	171.79	ksi	$0.44 \; F_y =$	22	ksi		
$\phi_{\rm c} =$	0.90	-					
$\phi_c P_n =$	1370.46	kip					
$P_u/\phi_c P_n =$ Check	0.44 0.50	use (H1-1 <i>a</i> <mark>OK</mark>	a)				

Title	TCBF	-B-3 Specin	nen Design	Calculation	Sheet	Date	May	28, 2009			
1F		Lower E	Beam Desig	gn Check		Page		7			
$R_yF_yA_g =$	453.20	kip	(1F)								
$R_yF_yA_g =$	338.80	kip	(2F)	$\theta =$	0.73	(rad)	42.0	(deg)			
$0.3 P_n =$	89.31	kip	(1F)	$\sin(\theta) =$	0.67						
$0.3 P_n =$	59.91	kip	(2F)	$\cos(\theta) =$	0.74						
	263.10	kip									
	292.33	kip									
	300.00	_	(conservat								
$M_u =$	160.72	kip-ft	(revised fr	om structura	l analysis)						
Tur	w2	169									
Try A _g =	20.1	in ²		h _c –	8.97	in					
_	1830	in ⁴		$t_{\rm f} =$		in					
	70.4	in ⁴			23.7	in					
-	9.55	in			0.415	in					
	9.55 1.87	in			50	ksi					
r _y –	1.07	111		1 у —	50	K91					
$\lambda_{n1} =$	9.15			b/t =	7.67	Compact					
	90.55			h/tw =		Compact					
_	6.61	ft			177	in ³					
с =	1	-			1.87	in ⁴					
$C_w =$	9430	in ⁶			23.12	in					
	154	in ³			2.30	in					
	18.74	ft		Brace PT=	2	-					
L _b =	10	ft		$C_b =$	1.0	(Conserv	vatively)				
	737.5	kip-ft		$F_{cr} =$	110.86	ksi					
· · ·	0.90	-			656.87	kip-ft		OK			
$\phi_b M_n =$		kip-ft									
		_									
	64.17	-		k =	1.0	-					
	69.50	ksi		$0.44 F_y =$	22	ksi					
	0.90	-									
$\phi_c P_n =$	669.33	kip									
$P_u/\phi_c P_n =$ Check	0.45 0.69	use (H1-1a <mark>OK</mark>	.)								

Title	TCBF	-B-3 Specir	nen Design Calculation	Sheet	Date	May 28, 2009
2F			mn Design Check		Page	8
P _u = M _u =	43.55 115.54	kip kip-ft	(revised from structura (revised from structura			
L _{column} =	9	ft				
Try	w1	2x96				
A _g =	28.2	in^2	$b_{f} =$	12.2	in	
$I_x =$	833	in^4	$t_f =$	0.9	in	
$I_y =$	270	in^4	d =	12.7	in	
$r_x =$	5.44	in	$t_w =$	0.55	in	
$r_y =$	3.09	in	$F_y =$	50	ksi	
$\lambda_{p1} =$	7.22		b/t =	6.78	Compact	
$\lambda_{p1} = \lambda_{p2} =$	71.62	-	h/tw =	19.82	Compact	
$\lambda_{p2} = L_p =$	10.91	- ft		19.82	in ³	
С =	10.91	-		6.85	in in ⁴	
$C = C_w =$	9410	in ⁶	$h_{o} =$	11.80	in	
$S_{\rm w} =$	131	in ³	$r_{ts} =$	3.49	in	
$L_r =$	40.86	ft		0	-	
$L_b =$	9	ft	$C_b =$		(Conserv	vatively)
$M_p =$	612.5	kip-ft	$F_{cr} =$		ksi	
$\phi_{b} =$	0.90	-		612.50		(Need Check)
		kip-ft	$C_a =$		-	
	34.95	-	k =	1.0	-	
	234.28	ksi	$0.44 \mathrm{F_y}$ =	22	ksi	
	0.90	-				
$\phi_c P_n =$	1160.56	kip				
$P_u/\phi_c P_n =$	0.04	use (H1-11	b)			
Check	0.23	OK				

Title	TCBF	-B-3 Specin	nen Design Calculation	Sheet	Date	May 28, 2009
1F			nn Design Check		Page	9
$P_u =$	492.31	kip	(revised from structural	l analysis)		
	259.53	_	(revised from structural			
1v1 _u —	239.33	Kip-It	(revised from structura)	1 anaiy 515)		
L_{column} =	9	ft				
Try	w1	2x96				
$A_g =$	28.2	in ²	$b_f =$	12.2	in	
$I_x =$	833	in ⁴	$t_{\rm f} =$	0.9	in	
$I_y =$	270	in ⁴		12.7	in	
$r_x =$	5.44	in	$t_w =$		in	
$r_{y} =$	3.09	in	$F_{y} =$		ksi	
1 y	5.07	111	r y	50	K51	
$\lambda_{p1} =$	7.22	-	b/t =	6.78	Compact	
	52.38	-	h/tw =	19.82	Compact	
$L_p =$	10.91	ft	$Z_x =$	147	in ³	
c =	1	-	J =	6.85	in ⁴	
$C_w =$	9410	in ⁶	$h_o =$	11.80	in	
$S_x =$	131	in ³	$r_{ts} =$	3.49	in	
$L_r =$	40.86	ft	Brace PT=	0	-	
$L_b =$	9	ft	C _b =	1.0	(Conserv	vatively)
$M_p =$	612.5	kip-ft	$F_{cr} =$	344.49	ksi	
$\phi_{b} =$	0.90	-	$M_n =$	612.50	kip-ft	(Need Check)
$\phi_b M_n =$	551.25	kip-ft	C _a =	0.39	-	
k1/r =	34.95	_	k =	1.0	_	
	234.28	ksi	$0.44 F_v =$		ksi	
	0.90	-	y			
	1160.56	kip				
· C- II	1100.00	F				
$P_u/\phi_c P_n =$	0.42	use (H1-1a	.)			
Check	0.84	OK				

		Check Column Web Shear Stress
$\begin{split} M_{p} &= 7350 \\ L &= 96.15 \\ V &= 152.89 \\ A_{s} &= 6.99 \\ S_{v} &= 21.89 \\ S_{v, \ yield} &= 29.00 \end{split}$	kip-in in kip in ² ksi ksi	$A_s = d*tw$ Elastic

Title	TCBF	-B-3 Specin	men Design C	alculation	Sheet	Date	May 28, 2	2009
2F			Column Conne			Page	10	
Type H = V = M =		(WUF-B) kip kip kip-ft		n structura	l analysis)	3		
$R_u =$	175.10	kip					\mathcal{R}_{0}	=
Try d _b =	0.88	in	$F_u =$	150	ksi			
$A_b =$	0.60	in ²	$F_{nv} =$	75	ksi	(threads ex	cluded)	
$N_b =$	6	bolts	(in one row)					
$R_n =$	270.59	kip	(bolt shear)			1.5	in	
$\phi_b =$	0.75	-			$L_{c_in} =$	3	in	
$\phi_b R_n =$	202.94	kip	OK					
$L_{c2} = t = R_n = R_n = 0$	1.03 2.06 0.50 1227.66	in in in kip	(edge clear d (clear distand (shear tab thi (combined be	ce) ickness)	$R_{n2} =$		kip kip	
	0.75 920.74	- kip	OK					
	18	in	-,		in^2	$R_n =$	524.79	kip
w _{tab} =	4.5	in	$F_{y, tab} =$		ksi	$P_{nt} =$		kip
			$F_{v, tab} =$	30.0	ksi	$P_{nv} =$	270.00 OK	kip
Weld	Fillet	(shea	ar tab)				UK	
$F_{exx} =$	70	ksi	,	$R_n =$	334.06	kip		
Fw =	42	ksi		$\phi_{\rm b} =$	0.75	-		
w =	5	x 1/16	inch	$\phi_b R_n =$	250.54	kip	OK	
L _{weld} = side =	18 2	in sides						
Weld	CJP	(top, bott	om flanges)					
$b_{f} =$	12.8	in		$F_{y, bm} =$	50	ksi	(base metal)	
$t_{\rm f} =$	0.85	in		$M_n =$	1063.07	kip-ft	OK	
d =	24.3	in						
$t_w =$	0.55	in						

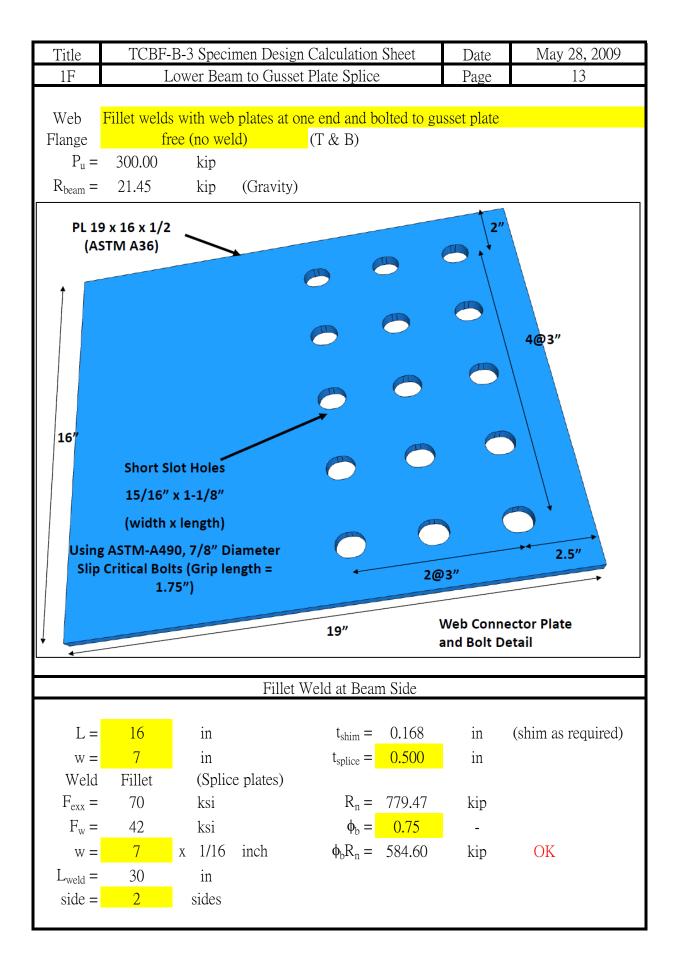
		Check Block Shear	
		Check Block Shear	
Beam			
w24x117			
$A_{gv} = 9.9$	in ²		
$A_{gt} = 1.925$	in ²		
$A_{nv} = 6.6$	in^2		
$A_{nt} = 1.65$	in ²		
$U_{bs} = 0.5$	-		
$\phi = 0.75$	-		
$F_y = 50$	ksi		
$F_u = 65$	ksi		
$\phi R_n = 233.27$	kip	OK	
~ ~ .			
Shear Tab	2		
$A_{gv} = 8.25$	in ²		
$A_{gt} = 1.5$	in^2		
$A_{nv} = 5.5$	in ²		
$A_{nt} = 1.25$	in ²		
$U_{bs} = 0.5$	-		
φ = 0.75	-		
$F_y = 50$	ksi		
$F_u = 65$	ksi		
$\phi R_n = 191.34$	kip	OK	

Title	TCBF	-B-3 Speci	men Design	Calculation	Sheet	Date	May 28, 2009
2F			to Beam Con			Page	11
Braces		W8x21					
T =	338.80	kip	$\sin(\theta) =$	0.669			
C =	241.62	kip	$\cos(\theta) =$	0.743			
e =	12.15	in					
Shear =	431.42	kip					
Tension $=$	182.56	kip	Ļ				L
	436.81	kip-ft				-	
$t_{gusset} =$	0.75	in		←	/L		e = 0.5 d
L =	60	in					= ▼
$s_V =$	9.59	ksi	/	\sim			\
$s_A =$	4.06	ksi	ζ	\Box	\smile		<i>\</i>
$s_M =$	11.65	ksi		X		X	\mathbf{X}
φ =	0.9	-	- Li	/		\	
$F_{y, gusset} =$	50	ksi	/~				ν`,
Ratio =	0.51	OK					
$L_{whitmore} =$	23.87	in	$L_{min} =$	62.68	in	(geometry l	imit) NG
$L_v =$	16	in	$L_{v, min} =$	17.74	in	(geometry l	imit) NG!
$w_{up} =$	11.93	in	$A_v =$	12	in ²		
$w_{low} =$	20.92	in	$P_u =$	226.65	kip		
$Whitm_{eff} =$	23.87	in	φR _n =	324	kip	ОК	
$\phi R_n =$	805.56	kip	OK		-		
• 11		шp	011				
			Gusset Pl	ate to Bear	n Flange		
Weld	Fillet						
$F_{exx} =$	70	ksi					
$F_w =$	42	ksi		$s_V =$	10.17	ksi	
w =	8	x 1/16	inch	$s_M =$		ksi	
$L_{weld} =$	60	in		$s_A =$		ksi	
side =	2	sides		$f_{peak} =$		ksi	
-	0.354	in			19.32	ksi	
$t_{eff} =$							
$\phi =$	0.75	- OV		$f_r =$		ksi OV	
Ratio =	0.68	OK		Ratio =	0.64	OK	
			Che	ck Beam W	leh		
width =	60	in	Beam		w24x117		
- maan -	00	111	Domin				

R., =	174.73	kip	d =	24.3	in	t _w =	0.55	in		
N =	30	in		0.85	in	$F_{y, web} =$		ksi		
$\phi =$	0.75	-		1060.63	kip	$\phi R_n =$		kip		
	1.35	in	11	1000.00	mp	(web crig		OK		
$\phi =$	1.00	-	$R_n =$	1010.63	kip		1010.63	kip		
т	1.00		11	1010000		(web local		OK		
	Check Gusset Plate Buckling									
L _{gb} =	17.68	in	kL/r =	98.0	-	$L_c =$	14.13	in		
k =	1.2	-	$F_e =$	29.82	ksi	$L_{c1} =$	11.38	in		
r =	0.217	in	$0.44 F_y =$	22	ksi	$L_{c2} =$	16.94	in		
A _g =	17.90	in^2	$R_n =$	443.70	kip	L _{max} =	24.06	in		
φ =	0.9	-	$\phi R_n =$	399.33	kip	$L_{tip} =$	21.88	in		
					OK	L _{ave} =	17.68	in		
			Free	Edge Bucl	kling					
$L_e =$	15.63	in								
$L_e/t_g =$	20.83	-								
Limit =	18.06	-	Edge stiffer	ner require	d!					
			T =4==1	04-1-11:4	£ D					
М —	1498.75	lrin ft	Lateral Z =	Stability o	in ³	Ι_	10	ft		
	1498.75	kip-ft			in in	$L_b =$		ft		
	15.34	-	$\beta_{br} =$	23.45 85.22			17.05 1	OK		
(Nodal)	13.34	kip	(Nodal)	03.22	kip/in	$C_b =$	1	OK		
(INOUAL)			(INOUAL)			C _b –	1	-		
$M_{br} =$	17.985	kip-ft								
$P_{br} =$	9.20	kip	(torsional)							
			β_{sec} not i	ncluded						
_			(torsional)							
	0.18	in								
				Kicker						
L3x2z		C								
$A_g =$	1.73	in ²								
L =	25 2006 8	in Irin/in								
k _{axial} = k =	2006.8 1419	kip/in kip/in	OK							
к =	1417	ктр/ш	ЛU							
L										

Title	Т	CBF-B-3	Specimen Design Calcu	ulation Sheet	Date	May 28, 2009
1F		Beam	-Column-Gusset Conne	ections	Page	12
	Bi	g Gusset I	Plate for Upper Floor B	racing and Lower	Floor Bracing	
Sv	vay to Rigl	nt		e.	V _U F _U	
$F_{U2R} =$	338.80	kip	$\cos(\theta_{\rm U}) = 0.743$		Hu	
	360.20	kip	$\cos(\theta_{\rm L}) = 0.743$			
S	way to Lef	Ìt				$-0.5 (H_{\rm U}+H_{\rm L})$
011	241.62	kip		W.P. Minterface	R _{beam}	- 0.3 (IIU+IIL)
	453.20	kip		W	l↓ Ž	
Beam	w24			V _{total}		
_	23.7	in				$- 0.5 (H_U + H_L)$
$L_{c, min} =$	60.74 w12	in				$V_{\text{total}} = V_{\text{U}} - V_{\text{L}} - R_{\text{beam}}$ $f_{\text{face}} = V_{\text{total}} \cdot e_{\text{c}}$
Column	6.35	in			́≁∖	
$C_c =$ $R_{beam} =$		kip	(downward)	•	V_L F_L	
$L_{b, min} =$	17.36	in				
$L_{b, min} =$ $L_{cu, min} =$	17.74	in				
$L_{cl, min} =$	19.29	in				
$t_{g} =$	0.75	in				
$L_{cu} =$	18	in	(use) $F_{y, gusset} =$	50 ks	i	
$L_{cl} =$	18	in	(use) I y, gusset –	50 K5	1	
$L_{cl} = L_{c}$	59.7	in	(use)			
$L_{b} =$	23	in	(use)			
		111	Sway to th	e Right		
$V_{U2R} =$	226.65	kip	(upward)	$s_{\rm V} = 9.9$	6 ksi	
$H_{U2R} =$		kip	(rightward)	$s_{\rm M} = 6.3$	6 ksi	
$V_{L2R} =$	240.96	kip	(upward)	$s_{\rm A} = 0.3$	6 ksi	
$H_{L2R} =$		kip	(leftward)	Ratio = 0.4		OK
$V_{total} =$	446.16	kip	(upward)			
M =	236.09	kip-ft	(counter-clockwise)			
				Colum	n-Side	
	134.52	kip	(downward)	$s_{A} = 4.4$	4 ksi	
	4.77	kip/in	(lefttward)	$s_{\rm V} = -9.9$	6 ksi	
f ₂ =	1.89	kip/in	(leftward)	$s_{\rm M} = 1.9$	2 ksi	
$H_{cu} =$	59.96	kip	(leftward)	Ratio = 0.4	1 -	OK
$H_{bu} =$	191.86	kip	(leftward)	Beam-	Side	
V _{bu} =	92.13	kip	(downward)	$s_{A} = 5.3$	4 ksi	
M_{cu} =	6.47	kip-ft	(counter-clockwise)	$s_V = 11.1$	2 ksi	

M _{bu} =	-91.90	kip-ft	(clockwise)	s _M = Ratio =	-16.68 0.50	ksi -	OK
$V_{cl} =$	134.52	kip	(downward)	$s_A =$	4.44	ksi	
$f_1 =$	4.77	kip/in	(rightward)	$s_V =$	9.96	ksi	
f ₃ =	1.89	kip/in	(rightward)	$s_M =$	1.92	ksi	
$H_{cl} =$	59.96	kip	(rightward)	Ratio =	0.41	-	OK
$H_{bl} =$	207.77	kip	(rightward)				
$V_{bl} =$	106.44	kip	(downward)	$s_A =$	6.17	ksi	
$M_{bl} =$	86.32	kip-ft	(clockwise)	$s_V =$	12.04	ksi	
$M_{cl} =$	6.47	kip-ft	(counter-clockwise)	$s_M =$	15.66	ksi	
				Ratio =	0.67	-	OK
$V_{mid} =$	136.01	kip	(downward)	$s_A =$	0.00	ksi	
$M_{mid} =$	8.71	kip-ft	(counter-clockwise)	$s_V =$	7.65	ksi	
$H_{mid} =$	0.00	kip	(leftward)	$s_M =$	1.49	ksi	
				Ratio =	0.30	-	OK
			Weld S	Size			
$f_v =$	7.47	kip/in					
$f_a =$	4.35	kip/in	(averaged)				
$f_b =$	4.77	kip/in					
$f_{peak} =$	11.79	kip/in					
$f_{avg} =$	9.64	kip/in					
$f_r =$	12.05	kip/in	12.04781				
D >=	4.33	x 1/16	(weld size)				
Use	6	x 1/16	(weld size)				



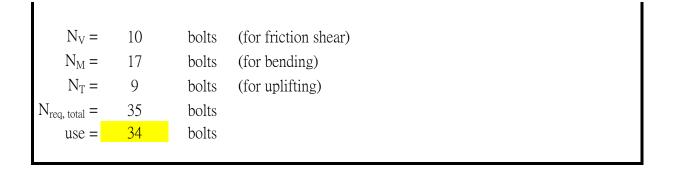
	Block Shear in Splice Plate									
$F_{u} = \phi =$ $A_{gv} =$ $A_{nt} =$ side =	36 58 0.75 7 8 2 1061.40	ksi - in ² sides kip	OK	Proposed Pin Connection Detail 7/5" gap between w24x68 beam and finger plate Shim as required at both side of beam web 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0						
			Block Shear in	Lower Beam Web						
$\varphi = \\ A_{gv} = \\ A_{nt} = \\ side = $	50 65 0.75 5.81 6.64 1 493.64	ksi ksi in ² in ² sides kip	OK							
			Bolt Stre	ength Check						
d _{bolt} = w _{slot} =	21.6	in in	(short slot) (TC bolts)							
			Block Shear	in Gusset Plate						
$A_{gv} = \\ A_{nt} = \\ A_{nv} =$	50 65 0.75 12.38 6.19 8.16 1 540.21	ksi ksi in ² in ² sides kip	OK							

L			0.1						
<u> </u>	Splice Plate Strength Check								
$F_y =$	36	ksi							
$F_u =$	58	ksi							
φ =	0.75	-							
$A_{gt} =$	8	in^2							
$A_{nt} =$	5.66	in ²							
side =	2	sides							
$\phi R_n =$	576.00	kip	OK	(gross yielding check)					
$\phi R_n =$	492.09	kip	OK	(net section check)					

Title	TCBF	-B-3 Speci	men Design	Calculation	Sheet	Date	May	28, 2009
1F			Floor Beam (Page		14
Braces		W8x28						
T =	453.20	kip	$\sin(\theta) =$	0.669				
C =	360.20	kip	$\cos(\theta) =$	0.743				
e =	0	in		Σ.				\sim
Shear =	604.60	kip			~			//
Tension $=$	237.46	kip		\rightarrow	$\langle \rangle$			
Moment =	0.00	kip-ft		$\langle \rangle$	$\langle \rangle$	\frown	Ľ/)
$t_{gusset} =$	0.75	in		\	× `\		/*	/ .
L =	46	in						
$s_V =$	17.52	ksi	$\mathbf{e} = 0.5 \; \mathbf{d}$	I L		`\L		Ļ
$s_M =$	0.00	ksi						- <u>/</u>
φ =	0.9	-						
F _{y, gusset} =	50	ksi						
Ratio =	0.69	OK						
whitmo =	25.96	in	$L_{min} =$	38.80	in	(geometry]	imit)	OK
$L_v =$	19	in	$L_{v, min} =$	19.29	in	(geometry]	imit)	NG!
			.,					
$w_{up} =$	12.98	in	$A_v =$	14.25	in2			
$w_{low} =$	14.12	in	$P_u =$	303.17	kip			
whit _{eff} =		in	φR _n =	384.75	kip			
	876.08	kip	OK		OK			
111	0,0100	шр	0 II		011			
Weld	Fillet	(Guss	set to beam f	lange)				
$F_{exx} =$	70	ksi						
$F_w =$	42	ksi						
	11	x 1/16	inch	$s_V =$	13.52	ksi		
$L_{weld} =$	46	in		$s_M =$		ksi		
$E_{weid} =$	2	sides		$s_{\rm M} =$ $s_{\rm A} =$		ksi		
	0.486			5 _A –	J.J1	К91		
$t_{eff} = \phi =$		in						
φ = Ratio =	0.75 0.76	OK						
Nau0 –	0.70	0K						
			Che	ck Beam W	Veb			
width =	46	in	Beam		w30x391			
$R_u =$	0.00	kip	d =	33.2	in	t _w =	1.36	in
∎ u		1				ŶŶ		

N =	23	in	$t_f =$	2.44	in	$F_{y, web} =$	50	ksi	
φ =	0.75	-	$R_n =$	4450.60	kip	$\phi R_n =$	3337.95	kip	
k _{des} =	3.23	in				(web cr	ippling)	OK	
φ =	1.00	-	$R_n =$	2662.20	kip	$\phi R_n =$	2662.20	kip	
						(web local	l yielding)	OK	
	Check Gusset Plate Buckling								
L _{gb} =	14.84	in	kL/r =	82.2	-	$L_c =$	15.88	in	
k =	1.2	-	$F_e =$	42.32	ksi	$L_{c1} =$	18.06	in	
r =	0.217	in	$0.44 F_y =$	22	ksi	$L_{c2} =$	12.56	in	
A _g =	19.47	in2	$R_n =$	593.65	kip	L _{max} =	18.56	in	
φ =	0.9	-	$\phi R_n =$	534.29	kip	$L_{tip} =$	9.13	in	
					OK	$L_{ave} =$	14.84	in	
			Free	Edge Buc	kling				
$L_e =$	17.88	in							
$L_e/t_g =$	23.83	-							
Limit =	18.06	-	Edge stiffer	ner require	ed!				
			T., (). 1	Q ₄ ,1,11,4	(D				
ЪЛ	((15.02	1: 0		Stability c		т	10	C.	
	6645.83	kip-ft	Z =		in3	$L_b =$	10	ft	
ŭ	1	-	-	30.76	in		17.05	ft	
	51.85	kip		288.07	kip/in	n =		OK	
(Nodal)			(Nodal)			$C_b =$	1	-	
М —	70 75	1-:				τ_	1550	:	
	79.75	kip-ft				$I_y =$	1550	in4	
$P_{br} =$		kip	(torsional)						
	108666	kip-in/rad		included					
$\beta_{br} =$	114.85	kip/in	(torsional)						
$\Delta =$	0.27	in							

Title	TCBF-B-3 Specimen Design Calculation Sheet					Date	May 28, 2009		
1F	Column Base Plate Design Check					Page	15		
Column		w12x96							
$Z_x =$	147	in3		L =	96.15	in			
$F_y =$	50	ksi		$V_{Mp} =$	152.89	kip			
$M_p =$	7350	kip-in							
	492.31	kip		d =		in			
$M_u =$	3114.35	kip-in		$b_f =$	12.2	in			
	01.05			C	26				
N =	31.25	in		f _{p, max} =	36	ksi			
B =	28	in :		a -	1009	1 size / ins			
e =	6.33	in	(Care - 11) /	$q_{max} =$	1008	kip/in			
$e_{cr} =$	15.38	in	(Small Mor	nent)					
Y = q =	18.60 26.47	in kip/in	OK						
q = m =	9.59	in	ΟK						
$f_p =$	0.95	ksi							
$t_{p, req} =$	1.98	in	eq 3.3.14a	(LRFD)					
use =	2.00	in	1						
			Al	l-thread-rod	S				
Tuna	ASTM A	102 27							
Type d _{bolt} =	1.125	in							
$G_{\text{bolt}} = F_{\text{u}} =$	1.125	ksi							
$F_{y} =$	105	ksi							
-	93.75	ksi							
$F_{nt} =$ $F_{nv} =$	50	ksi							
	0.99	in ²							
	0.99	1n -							
	69.89	kip	(tension)						
	37.28	kip	(shear)						
	86.98	kip		required pre	etension)				
	152.89	kip	(minimum required pretension) (very conservative assumption)						
	7350	kip-in	(very conservative assumption)						
$P_u =$	600	kip	(very conservative assumption)						
	0.35		(class A su						
SF =	2	-			aving enou	ugh bolt pre	tension force)		



Title	TCBF-B-3 Specimen Design Calculation Sheet					Date	May 28, 2009			
2F			Stub Beam			Page	16			
F1 =	300	kip		d =	24.3	in				
F2 =	600	kip		$t_w =$	0.55	in				
L _{stub} =	19	in		b =	12.8	in				
Beam	w242	x117		$t_f =$	0.85	in				
	Column Dimension List									
Column	w12	x96								
$A_g =$	28.2	in^2		$b_f =$	12.2	in				
$I_x =$	833	in ⁴		$t_f =$	0.9	in				
$I_y =$	270	in ⁴		d =	12.7	in				
$r_x =$	5.44	in		$t_w =$	0.55	in				
r _y =	3.09	in		$F_y =$	50	ksi				
$k_{des} =$	1.5	in		$E_s =$	29000	ksi				
Column Web Local Yielding										
	24.00	in								
	866.25	kip								
	1.00	-								
$\phi R_n =$	866.25	kip	OK							
Column Web Crippling										
R –	1382.366	kip	Colum		pnng					
	0.75	кір -								
	1036.77	kip	OK							
111	1000177	шр								
Column Flange Local Bending										
$R_n =$	253.13	kip	A _{web} =	12.43	in^2	$A_s =$	34.19 in ²			
$\phi =$	0.90	-	$A_{flange} =$	21.76	in^2					
$\phi R_n =$	227.81	kip	F1 _{flange} =	190.93	kip					
		-	F2 _{flange} =		kip	Contin	ue Plate Required!			
Stub Beam Gross Yielding										
$A_{s (beam)} =$	34.4	in ²								
$P_y =$	1720	kip	OK							

Title	TCBF-	B-3 Speci	men Design	Date	May 28	, 2009				
1F		*	Stub Beam	Page	17					
F ₁ =	300	kip		d =	23.7	in				
$F_2 =$	600	kip		$t_w =$	0.415	in				
L _{stub} =	19	in		b =	8.97	in				
Beam	w24	x68		$t_f =$	0.585	in				
Column Dimension List										
Column	w12x96									
$A_g =$	28.2	in^2		$b_f =$	12.2	in				
$I_x =$	833	in ⁴		$t_{\rm f}$ =	0.9	in				
$I_y =$	270	in ⁴		d =	12.7	in				
$r_x =$	5.44	in		$t_{\rm w} =$	0.55	in				
r _y =	3.09	in		$F_y =$	50	ksi				
$k_{des} =$	1.5	in		$E_s =$	29000	ksi				
Column Web Local Yielding										
N =	24.00	in								
$R_n =$	866.25	kip								
φ =	1.00	-								
$\phi R_n =$	866.25	kip	OK							
			Colum	n Web Crip	pling					
$R_n =$	1382.366	kip		1	1 0					
	0.75	-								
$\phi R_n =$	1036.77	kip	OK							
Column Flange Local Bending										
$R_n =$	253.13	kip		9.35	in ²	$A_s =$	19.84	in^2		
$\phi =$	0.90	-	$A_{flange} =$	10.49	in ²					
$\phi R_n =$	227.81	kip	F1 _{flange} =	158.65	kip					
			F2 _{flange} =	317.31	kip		ОК			
Stub Beam Gross Yielding										
$A_{s (beam)} =$	20.1	in^2			8					
$P_y =$	1005	kip	OK							
- y	1000	P								