Assignment #10

For the special concentric braced frames (SCBF) in Assignment #7, find the following

1. Required sizes of braces using HSS
2. Required sizes of columns using W14
3. Forces between columns & foundations

Note: P_D & P_L are in Assignment #6 for interior column

Lateral Forces from Assignment #7

Story	F_x (k)	V_x (k)
Roof	426.5	426.5
5th	329.9	756.4
4th	247.1	1003.5
3rd	164.4	1167.9
2nd	81.9	1249.8

Assume the length of the brace is

$$L_{brace} = L_{diag} - 2a$$

where $a = 3.5'$

Assignment #10 Special Concentric Braced Frame

Story	hx	L brace (1)		Fx	Vx	F brace (2)	Brace	Ag	ϕPn	T=RyFyAg	Cmin=0.3 Pn	Cmax=1.1RyPn	ϕVn (3)	PE(C)/story	PE(T)/story
Roof		15.0	18.0	426.5	426.5	266.6	7x7x1/2	12.4	305.0	868.0	101.7	521.9	519.6	0.0	0.0
5th		15.0	18.0	329.9	756.4	472.8	8x8x5/8	17.4	478.0	1218.0	159.3	817.9	741.1	791.8	694.4
4th		15.0	18.0	247.1	1003.5	627.2	10x10x3/4	26.3	868.0	1841.0	289.3	1485.2	1155.1	0.0	0.0
3rd		15.0	18.0	164.4	1167.9	729.9	12x12x3/4	32.3	1147.0	2261.0	382.3	1962.6	1438.1	1530.2	1334.0
2nd		15.0	18.0	81.9	1249.8	781.1	12x12x3/4	32.3	1147.0	2261.0	382.3	1962.6	1438.1	0.0	0.0
														229.4	1356.6
Ry =		1.4													
Fy =		50													

(1) L brace = L diagonal - 2 a L diagonal = 25 feet a = 3.5 feet
(2) F brace = Vx/2 braces/cos θ cos θ = 0.8
(3) ϕVn = 0.3 ϕc Pn + ϕt FyAg

Story	PE (Comp)	PE (Tension)	P(D)	R*P(L)	PU (Comp)	PU (Tens)	Column	ϕPn
Roof	0.0	0.0	98.4	14.4	159.7	54.1	W14x43	292.0
5th	791.8	694.4	207.6	39.5	1133.3	-580.2	W14x109	1210.0
4th	791.8	694.4	316.8	57.6	1311.6	-520.2	W14x120	1340.0
3rd	2322.0	2028.4	426.0	81.6	3023.1	-1794.1	W14x283	3270.0
2nd	2322.0	2028.4	535.2	105.6	3204.4	-1734.0	W14x283	3270.0
Foundation	2551.4	3385.0	535.2	105.6	3433.8	-3090.6		

PU (Comp) = 1.55 P(D) + 0.5 P(L) +PE (Comp)
PU (Tens) = 0.55 P(D) - PE(Tens)

P (foundations) = P(D) + P(L) + PE 3192.2 Down
P (foundations) =).55 * P(D) - PE -3090.6

Jumbo Square HSS (CSA)

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Shape	Design Wall Thickness, t	Nominal Wt	Area, A	b/t	h/t	I	S	r	Z	Torsion		Surface Area
										J	C	
	in.	lb/ft	$in.^2$			$in.^4$	$in.^3$	in.	$in.^3$	$in.^4$	$in.^3$	ft^2/ft
HSS22X22X7/8	0.875	244.88	72.0	22.1	22.1	5280	480	8.56	565	8420	778	7.08
X3/4	0.750	212.00	62.3	26.3	26.3	4630	421	8.62	492	7330	676	7.12
HSS20X20X7/8	0.875	221.06	65.0	19.9	19.9	3900	390	7.75	461	6260	638	6.42
X3/4	0.750	191.58	56.3	23.7	23.7	3430	343	7.81	403	5460	554	6.45
X5/8	0.625	161.40	47.4	29.0	29.0	2940	294	7.88	342	4620	468	6.49
X1/2	0.500	130.52	38.4	37.0	37.0	2410	241	7.92	279	3760	380	6.52
X3/8	0.375	98.94	29.1	50.3	50.3	1850	185	7.97	213	2870	289	6.56
HSS18X18X7/8	0.875	197.24	58.0	17.6	17.6	2780	309	6.92	368	4500	511	5.75
X3/4	0.750	171.16	50.3	21.0	21.0	2460	273	6.99	322	3930	445	5.79
X5/8	0.625	144.39	42.4	25.8	25.8	2110	234	7.05	274	3340	376	5.82
X1/2	0.500	116.91	34.4	33.0	33.0	1740	193	7.11	224	2720	306	5.86
X3/8	0.375	88.73	26.1	45	45	1340	149	7.17	172	2080	233	5.89
HSS16X16X7/8	0.875	173.43	51.0	15.3	15.3	1900	238	6.10	285	3100	398	5.08
X3/4	0.750	150.75	44.3	18.3	18.3	1690	211	6.18	250	2720	347	5.12
HSS14X14X7/8	0.875	149.61	44.0	13.0	13.0	1230	176	5.29	213	2030	299	4.42
X3/4	0.750	130.33	38.3	15.7	15.7	1100	157	5.36	188	1790	262	4.45
HSS12X12X3/4	0.750	109.91	32.3	13.0	13.0	666	111	4.54	134	1100	188	3.79
HSS10X10X3/4	0.750	89.50	26.3	10.3	10.3	364	72.8	3.72	89.4	610	127	3.12

HSS 10x10x3/4 $L=18'$ $KL/r = 58.1$ $\phi F_{cr} = 33.0$ ksi $\phi P_n = 868^K$

HSS 12x12x3/4 $L=18'$ $KL/r = 47.6$ $\phi F_{cr} = 35.5$ ksi $\phi P_n = 1147^K$

HSS 14x14x7/8 $L=18'$ $KL/r = 40.8$ $\phi F_{cr} = 37.0$ ksi $\phi P_n = 1628^K$

$F_y = 46$ ksi