Assignment #12

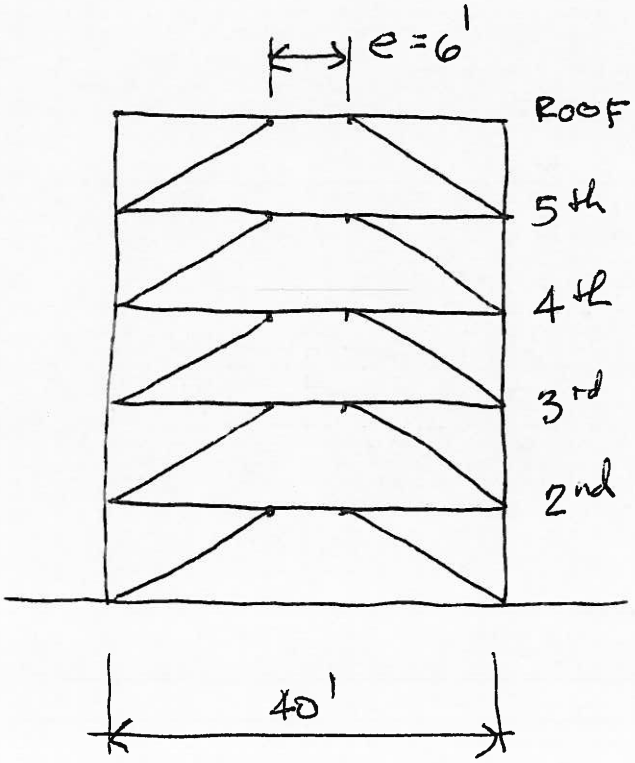
Use the Eccentric Braced Frame (EBF) configuration shown below and the same forces as used in Assignment #11 for BRBF ($R=8$ $C_t=0.03$ $x=0.75$)

(1) Estimate a Link Beam size, using W24, for each story. Steps 1-5 in notes.

(2) At the second floor only:

(a) Check the beam outside the link W24x103

(b) Determine brace size (W14)



(3) What would you change to make a more effecient EBF design? e? Link d?

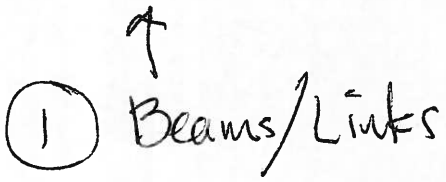
Assignment #12 Eccentric Braced Frame W24 Llink Beams 2017

Story	hx	L brace (1)	Fx	Vx	Vu -Link	tw	Mp	Z	Area
Roof	15.0	18.0	231.6	231.6	86.9	0.146	260.6	69.5	15.4
5th	15.0	18.0	174.2	405.7	152.1	0.256	456.4	121.7	27.0
4th	15.0	18.0	125.7	531.5	199.3	0.336	597.9	159.5	35.4
3rd	15.0	18.0	79.4	610.9	229.1	0.386	687.3	183.3	40.7
2nd	15.0	18.0	36.2	647.2	242.7	0.409	728.1	194.2	43.1

Ry =	1.1	ϕ =	0.9
Fy =	50	ksi	
L =	40	feet	
h =	15	feet	
e =	6	feet	
d-link +/- =	24	inches	
tf - link +/- =	1	inches	

Req'd tw = Vu / [ϕ 0.6 Fy (d-2 tf)]

Story		d	tw	tf	Z	A	Pu	Pu/Py	Vp	Vpa	Mpa	Shear Link e(max)	Flexural Link e(min)	Vp=2Mp/e
Roof	W24x55	23.6	0.395	0.505	134.0	16.2	115.8	0.143	267.3	264.6	516.9	3.13	5.08	186.1
5th	W24x76	23.92	0.440	0.680	200.0	22.4	202.9	0.181	297.8	292.9	754.1	4.12	6.69	277.8
4th	W24x76	23.92	0.440	0.680	200.0	22.4	265.8	0.237	297.8	289.3	727.8	4.03	6.54	277.8
3rd	W24x84	24.1	0.470	0.770	224.0	24.7	305.5	0.247	318.1	308.2	809.7	4.20	6.83	311.1
2nd	W24x84	24.1	0.470	0.770	224.0	24.7	323.6	0.262	318.1	307.0	801.8	4.18	6.79	311.1

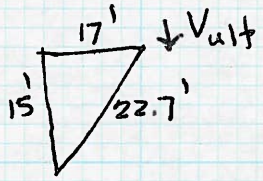


(2) W24×103 { $I = 3000\ in^4$ & $Z =$; $A = 30.3$ $d = 24.53$ $t_w = 0.55$ $t_{bf} = 0.98$

$V_p = 0.6(50)(24.53 - 2\times 0.98)\,0.55 = 372.4^K$

$V_{ult} = 1.25 R_y V_p = 1.25 \times 1.1 \times 372.4 = 512^K$

(b) Brace $P_u = V_{ult} \times \frac{22.7'}{15'}$



$= 775^K$

Assume $L = 19'$

W14×90 $\phi P_n = 1031^K$ $I = 1000\ in^4$

(a) $M_{ult} = \frac{eV_{ult}}{2} = \frac{6 \times 512}{2} = 1536^{'K}$

$$M_{bol} = \frac{(I/L)_{bol}}{(I/L)_{bol} + (I/L)_{brace}} \times M_{ult}$$

$$= \frac{(3000/17)}{(3000/17) + (999/22.7)} \times 1536 = 0.80 \times 1536 = 1229^{'K}$$

$L_p = 7.03'$ brace at $6'$ $KL/r = \frac{1 \times 6' \times 12}{1.99} = 36.2$

$\phi F_{cr} = 40.9$ $\phi P_n = A_g \phi F_{cr} = 30.3 \times 40.9 = 1239^K$

$P_u/\phi P_n = 775/1239 = 0.63 > 0.2$

$$\left[\frac{P_u}{\phi P_n} + \frac{8}{9}\frac{M_n}{\phi M_n}\right] \times 1.1 = \left[0.63 + \frac{8}{9} \times \frac{1229 \times 12}{0.9 \times 50 \times 280}\right] \times 1.1$$

$$= [0.63 + 1.04] \times 1.1 = 1.84 \gg 1.0$$

(3) Decrease $e = 4' \rightarrow M_{bol} = 819^{'K}$ helps

& smaller/lighter beam