Structural Calculations

1717 4th Street, Santa Monica, California 90401

Volume 1 of 1

Submitted to:
Square Mile Capital
Management, LLC
350 Park Ave, 15th Floor
New York, NY 10022
T:212.605.1000

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Englekirk
STRUCTURAL ENGINEERS

888 S. Figueroa Street
18th Floor
Los Angeles, CA 90017

323.733.6673 T

www.englekirk.com

TABLE OF CONTENTS

1717 4th Street
19-L173

STRUCTURAL CALCULATIONS
DATE: February 21, 2020

VOLUME 1

Development of Nonlinear Model

Development of Nonlinear Model of Existing Building

General Modeling

Material Properties
Fixity of Nodes
Slaving of Rigid Diaphragms
Mass of Structure

Gravity Loading

Gravity Column Loading
Moment Frame Column Loading
Moment Frame Beam Loading

Moment Frames

W Shaped Steel Beams
W Shaped Steel Columns

Seismic Evaluation of Existing Building via NSP

Target displacement

Positive H1 Direction
Positive H2 Direction
Negative H1 Direction
Negative H2 Direction

General Modeling

1. Material Properties

Moment frame beam and columns

A572 G50
Fy = 50 ksi
Fu = 65 ksi

Gravity frame beams and columns

Fy = 36 ksi

2. Fixity of Nodes

Moment frame are fixed at the end.

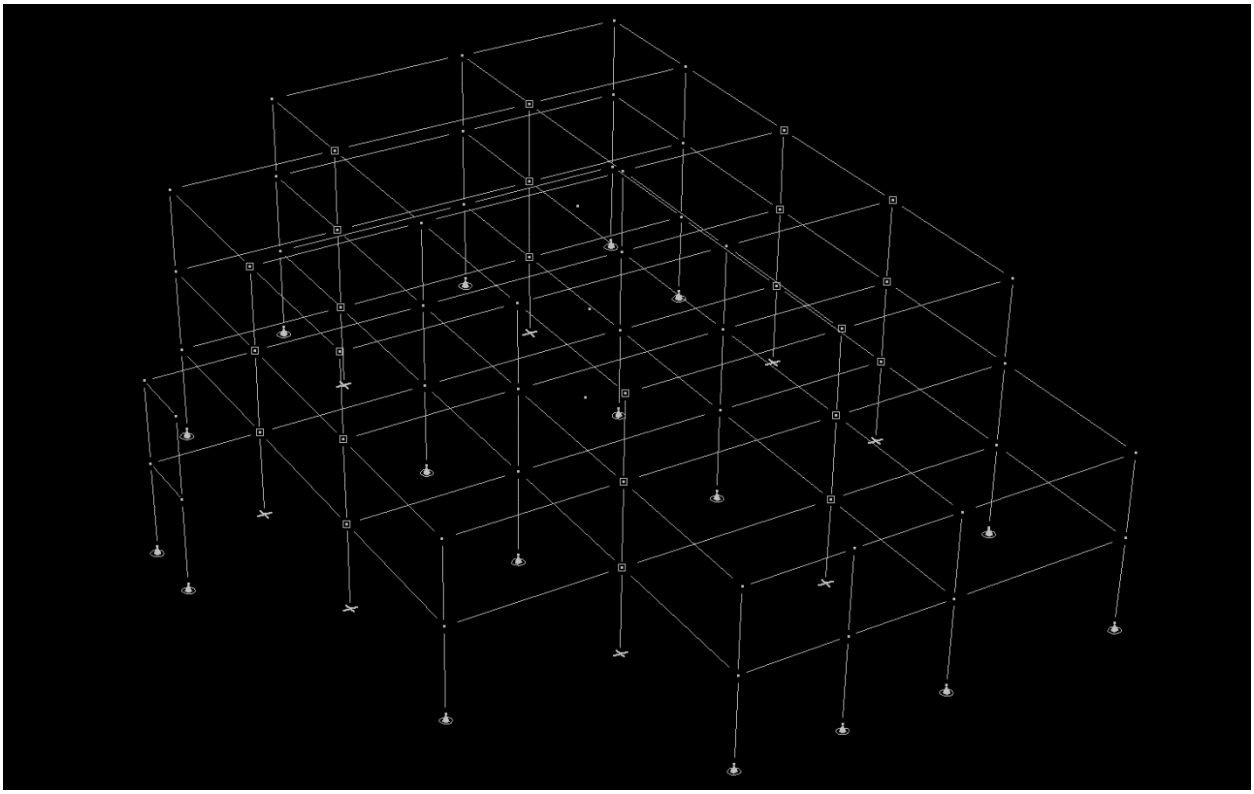


Figure 1- Fixity of Moment Frames (Fixed)

3. Slaving of Rigid Diaphragms

The diaphragm assumed to be rigid and the nodes are slaved at each level.

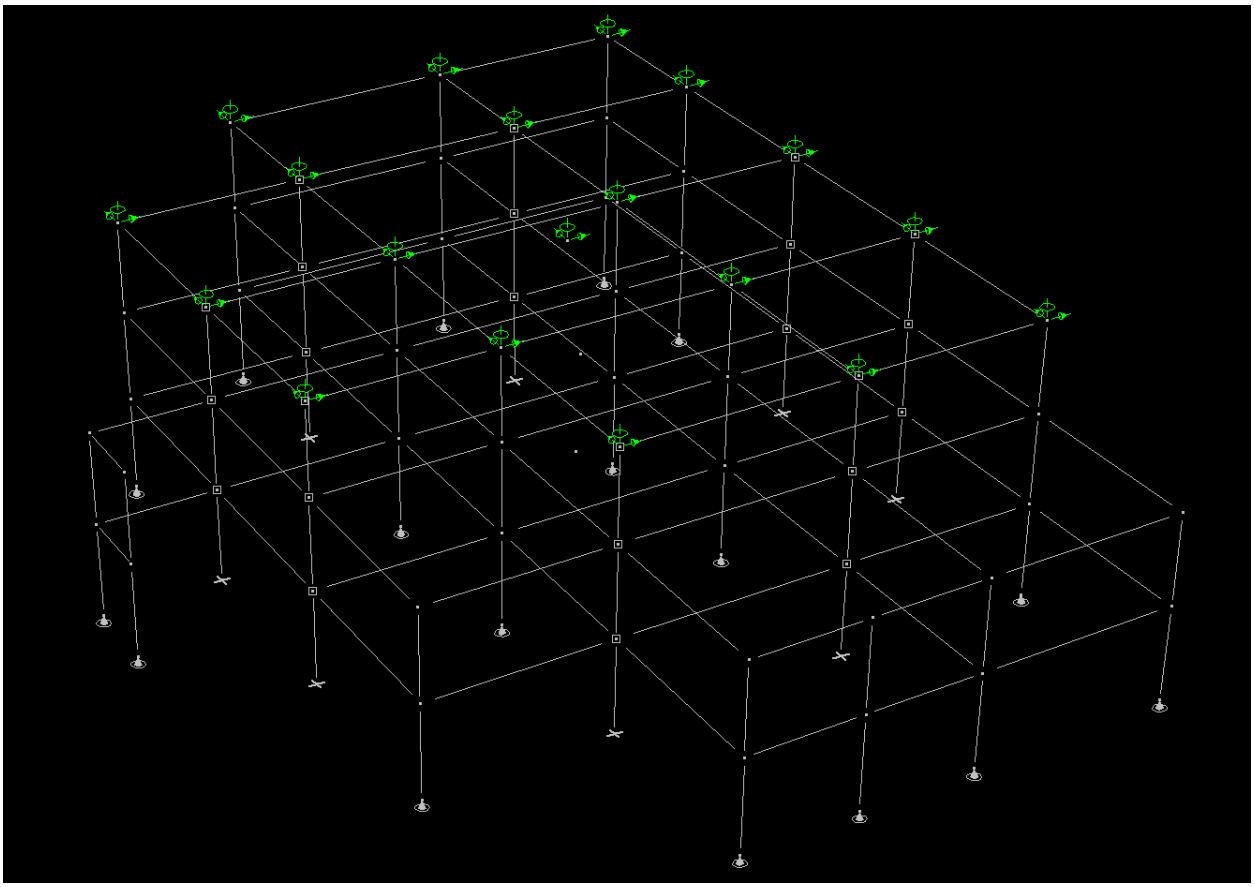


Figure 2- Slaving of Roof

4. Mass of Structure

The mass of the structure is applied at center of mass of diaphragm at each level. Masses are derived from DL+0.25LL.

STORY MASS DATA:

Includes Self Mass of:

Beams
Columns (Half mass of columns above and below)
Walls (Half mass of walls above and below)
Slabs/Deck

Floor LL = 50 psf
Roof LL = 20 psf

Calculated Values:

Story	Diaph #	Weight kips	Mass k-s2/ft	MMI ft-k-s2	Xm ft	Ym ft	EccX ft	EccY ft
Roof	1	680.06	21.12	39023	66.25	77.50	4.60	6.45
3rd	1	936.38	29.08	61847	64.56	70.99	5.07	7.05
2nd	1	987.87	30.68	68031	62.86	69.12	5.45	7.05

Story	Diaph #	Combine
Roof	1	None
3rd	1	None
2nd	1	None

DL+0.25LL
Roof : 1.886 [K-s^2/in]
3rd : 2.802 [K-s^2/in]
2nd : 2.936 [K-s^2/in]

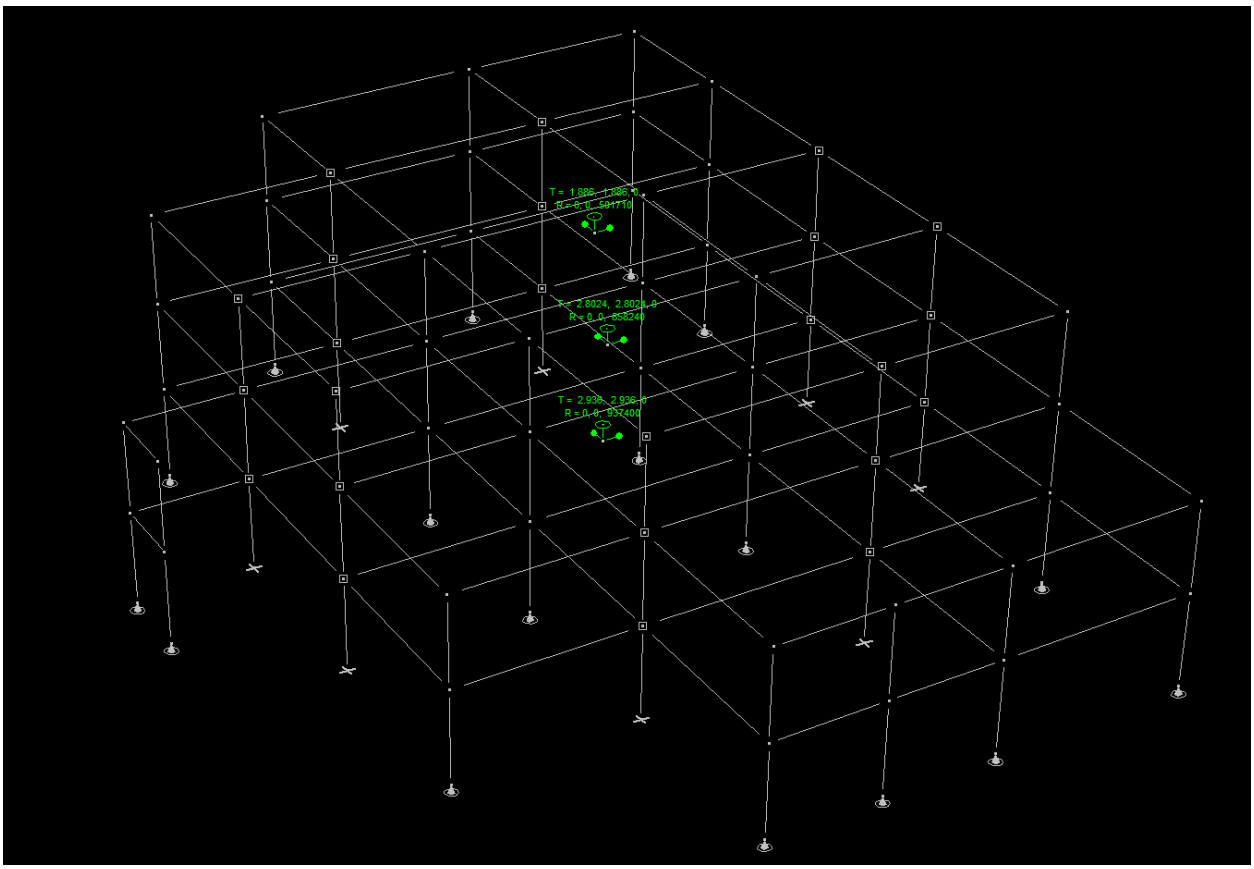


Figure 3- Mass of Structure (DL+0.25LL)

Gravity Loading

Governing load combination is DL+0.25LL

1. Gravity Column Loading

2. Moment Frame Column Loading

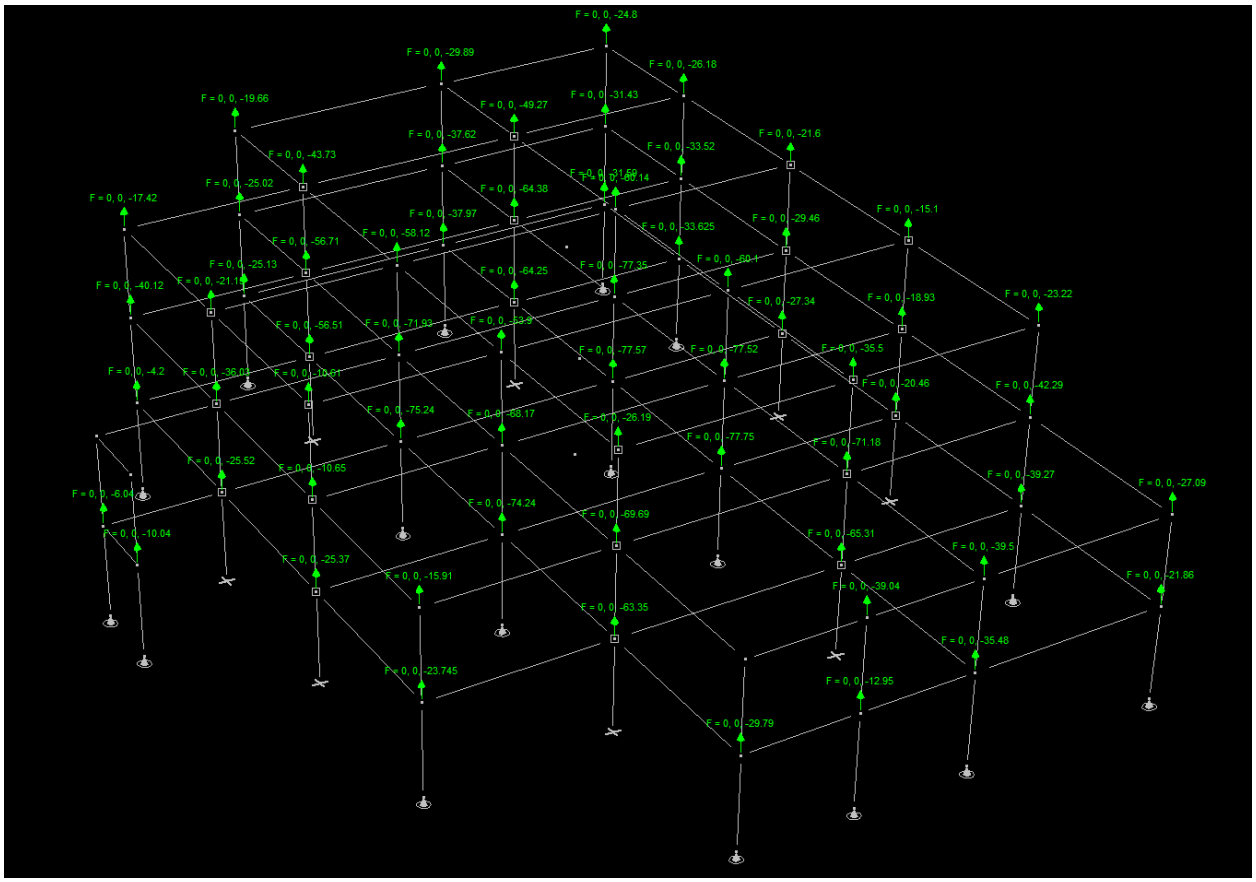


Figure 4- Columns Gravity Loading

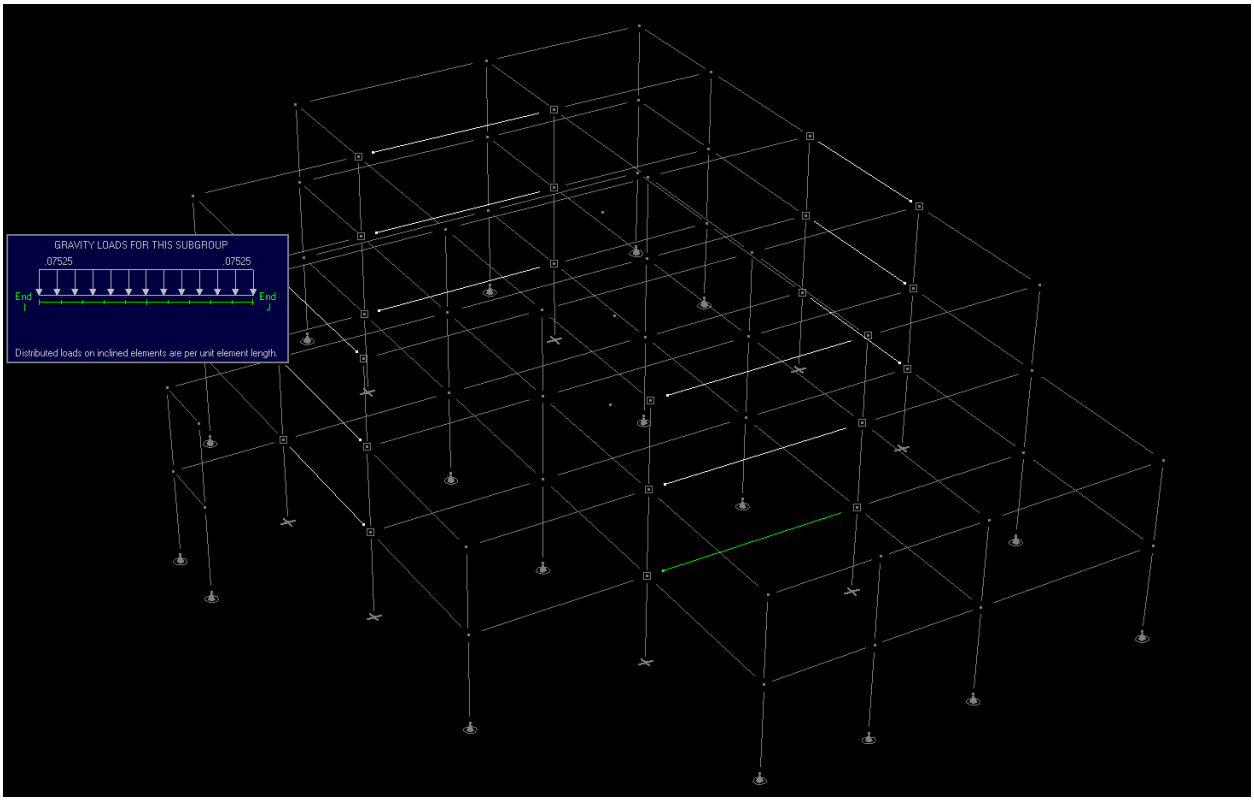


Figure 5- Moment Frame Beam Gravity Loading (Distributed) (Beam-1 1st Floor)

Moment Frame

1. W Shaped Moment Beams

1. 1 Cross Sectional

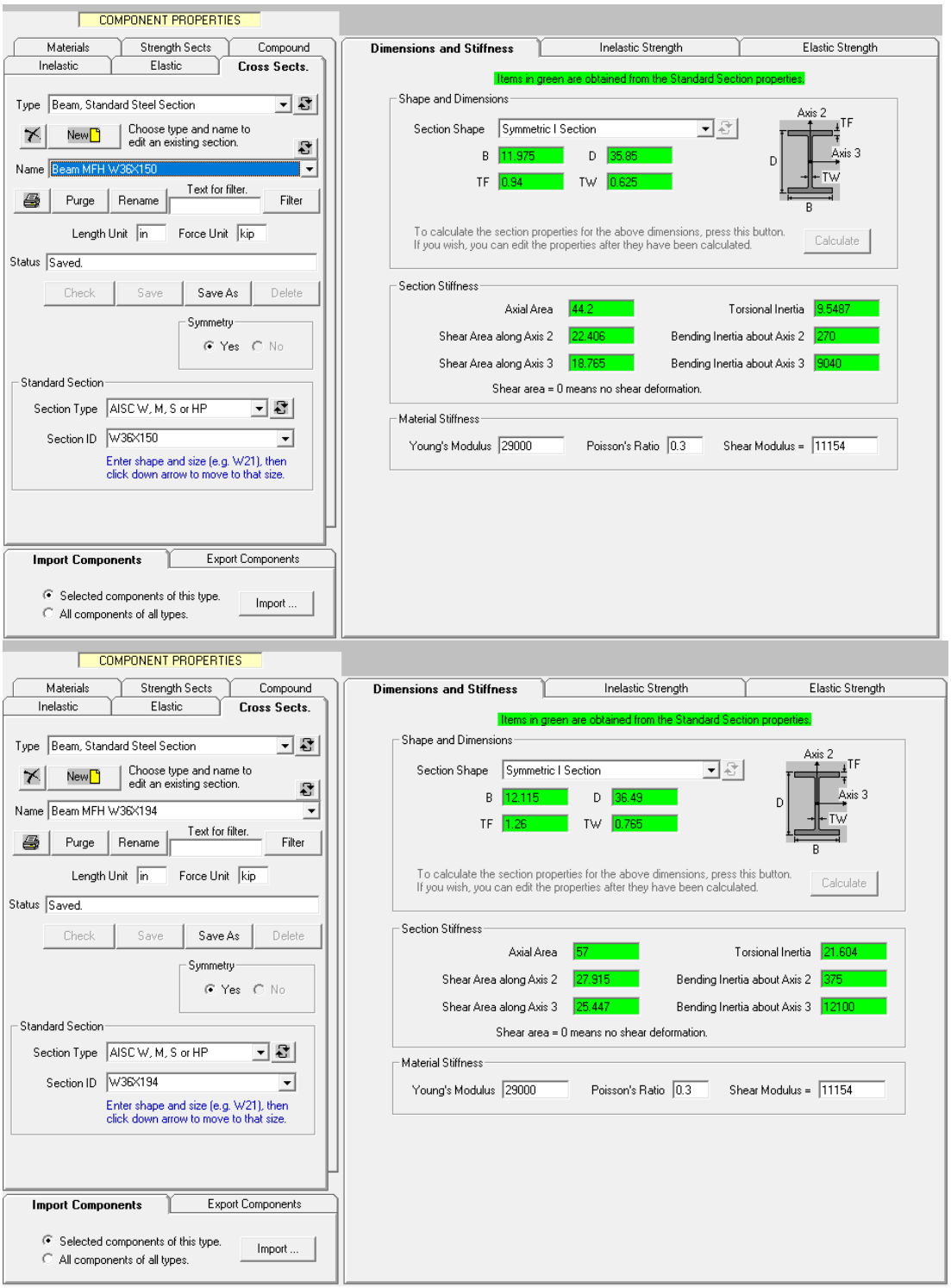


Figure 6 - Cross Section for Beams W 36X150 and W 36X194

2. 1 ASCE 41-13 Modeling Parameters

Plastic Moment Hinge (Table 9-6)

52/(Fye)^0.5 = 7.35
418/(Fye)^0.5 = 59.11

Beam W36X194
bf/2tf = 4.18
h/tw = 42.2
Beam W36X150
bf/2tf = 6.37
h/tw = 51.9

Table 9-6. Modeling Parameters and Acceptance Criteria for Nonlinear Procedures—Structural Steel Components

Component or Action	Modeling Parameters: Plastic Rotation Angle, Radians — *a*	*b*	Residual Strength Ratio — *c*	Acceptance Criteria: Plastic Rotation Angle, Radians — IO	LS	CP
Beams—Flexure						
a. $\frac{b_f}{2t_f} \le \frac{52}{\sqrt{F_{ye}}}$ and $\frac{h}{t_w} \le \frac{418}{\sqrt{F_{ye}}}$	$9\theta_y$	$11\theta_y$	0.6	$1\theta_y$	$9\theta_y$	$11\theta_y$
b. $\frac{b_f}{2t_f} \ge \frac{65}{\sqrt{F_{ye}}}$ or $\frac{h}{t_w} \ge \frac{640}{\sqrt{F_{ye}}}$	$4\theta_y$	$6\theta_y$	0.2	$0.25\theta_y$	$3\theta_y$	$4\theta_y$
c. Other	Linear interpolation between the values on lines a and b for both flange slenderness (first term) and web slenderness (second term) shall be performed, and the lower resulting value shall be used					
Columns—Flexure[a,b]						
For $P/P_{CL} < 0.2$						
a. $\frac{b_f}{2t_f} \le \frac{52}{\sqrt{F_{ye}}}$ and $\frac{h}{t_w} \le \frac{300}{\sqrt{F_{ye}}}$	$9\theta_y$	$11\theta_y$	0.6	$1\theta_y$	$9\theta_y$	$11\theta_y$
b. $\frac{b_f}{2t_f} \ge \frac{65}{\sqrt{F_{ye}}}$ or $\frac{h}{t_w} \ge \frac{460}{\sqrt{F_{ye}}}$	$4\theta_y$	$6\theta_y$	0.2	$0.25\theta_y$	$3\theta_y$	$4\theta_y$
c. Other	Linear interpolation between the values on lines a and b for both flange slenderness (first term) and web slenderness (second term) shall be performed, and the lower resulting value shall be used					
For $0.2 \le P/P_{CL} \le 0.5$						
a. $\frac{b_f}{2t_f} \le \frac{52}{\sqrt{F_{ye}}}$ and $\frac{h}{t_w} \le \frac{260}{\sqrt{F_{ye}}}$	—[c]	—[d]	0.2	$0.25\theta_y$	—[e]	—[d]
b. $\frac{b_f}{2t_f} \ge \frac{65}{\sqrt{F_{ye}}}$ or $\frac{h}{t_w} \ge \frac{400}{\sqrt{F_{ye}}}$	$1\theta_y$	$1.5\theta_y$	0.2	$0.25\theta_y$	$1.2\theta_y$	$1.2\theta_y$
c. Other	Linear interpolation between the values on lines a and b for both flange slenderness (first term) and web slenderness (second term) shall be performed, and the lower resulting value shall be used					
Column Panel Zones	$12\theta_y$	$12\theta_y$	1.0	$1\theta_y$	$12\theta_y$	$12\theta_y$
Fully Restrained Moment Connections[f]						
WUF[g]	$0.051-0.0013d$	$0.043-0.00060d$	0.2	$0.026-0.00065d$	$0.0323-0.00045d$	$0.043-0.00060d$
Bottom haunch in WUF with slab	0.026	0.036	0.2	0.013	0.0270	0.036

52/(Fye)^0.5 = 7.35
300/(Fye)^0.5 = 42.43
Column W14X283
bf/2tf = 3.89
h/tw = 8.84
Column W14X233
bf/2tf = 4.62
h/tw = 10.7
P/Pcl = 0.12

Modification factors for FR Beam-Column Connections ASCE41-13 per section 9.4.2.4.3

Mod.1 9.4.2.4.3-4.1	Mod.2 9.4.2.4.3-4.2	Mod.3 9.4.2.4.3-4.3	Mod.4 9.4.2.4.3-4.4
1.0	0.8	1.0	1.0

Modeling Parameters and Acceptance Criteria

WUF	d	a	b	c	IO	LS	CP
W 36X194	36.5	0.00284	0.0169	0.16	0.00182	0.0127	0.0169
W 36X150	35.9	0.00346	0.0172	0.16	0.00213	0.0129	0.0172

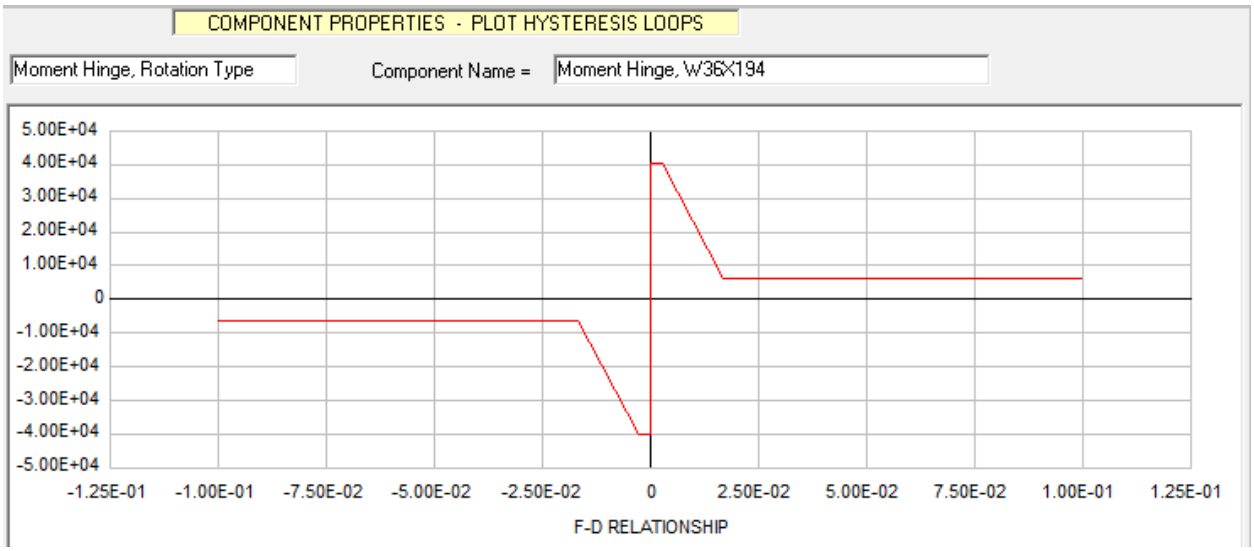


Figure 7- Deformation Capacities for Beam W 36X194

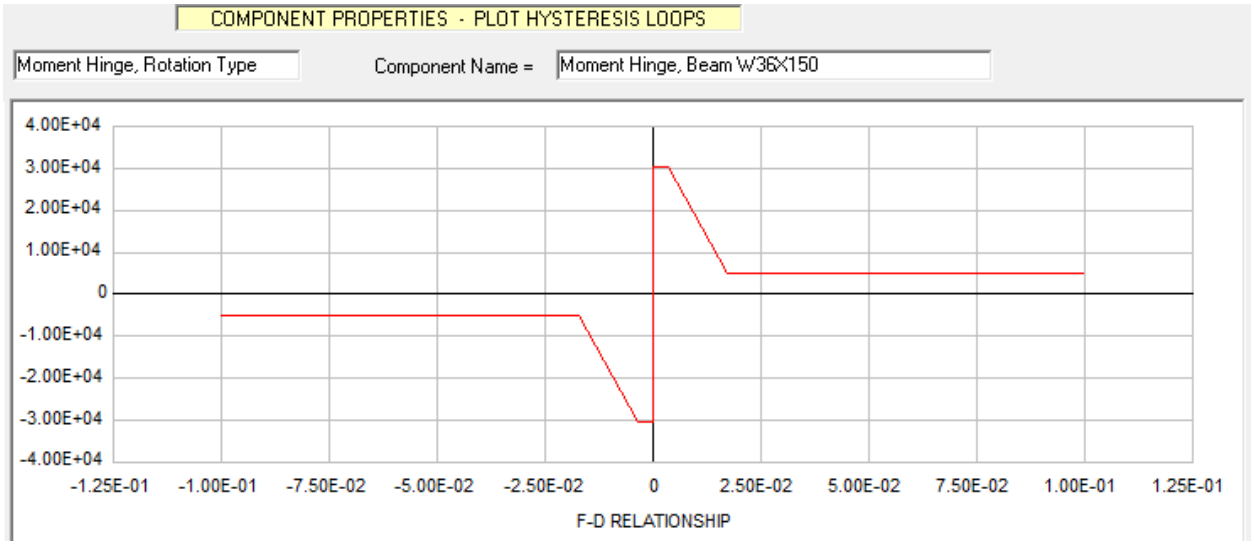


Figure 8- Deformation Capacities for Beam W 36X150

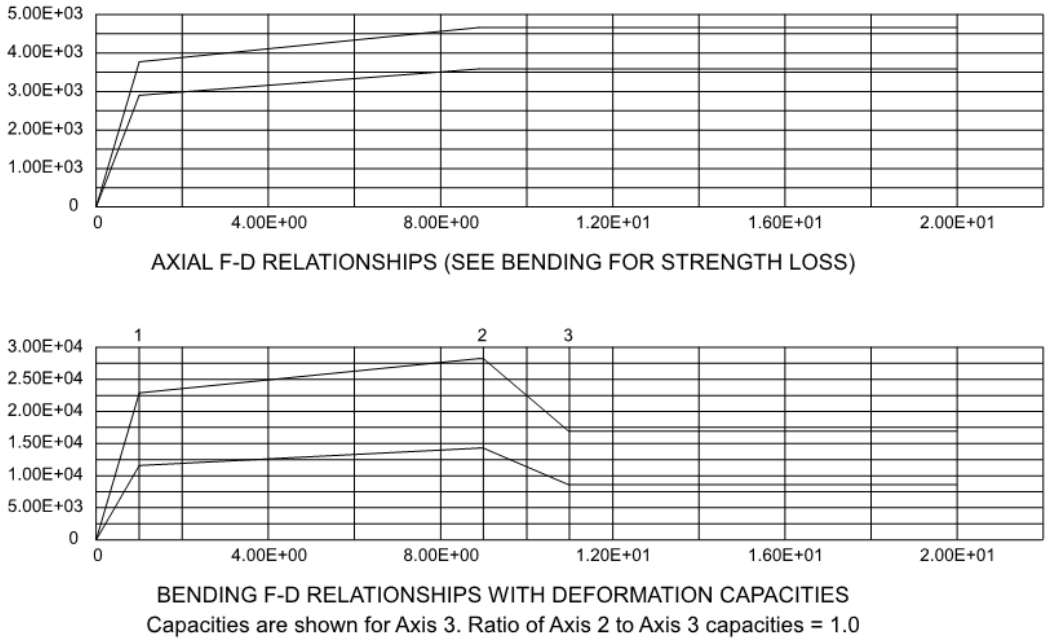


Figure 9- Deformation Capacities for Col. W 14X233

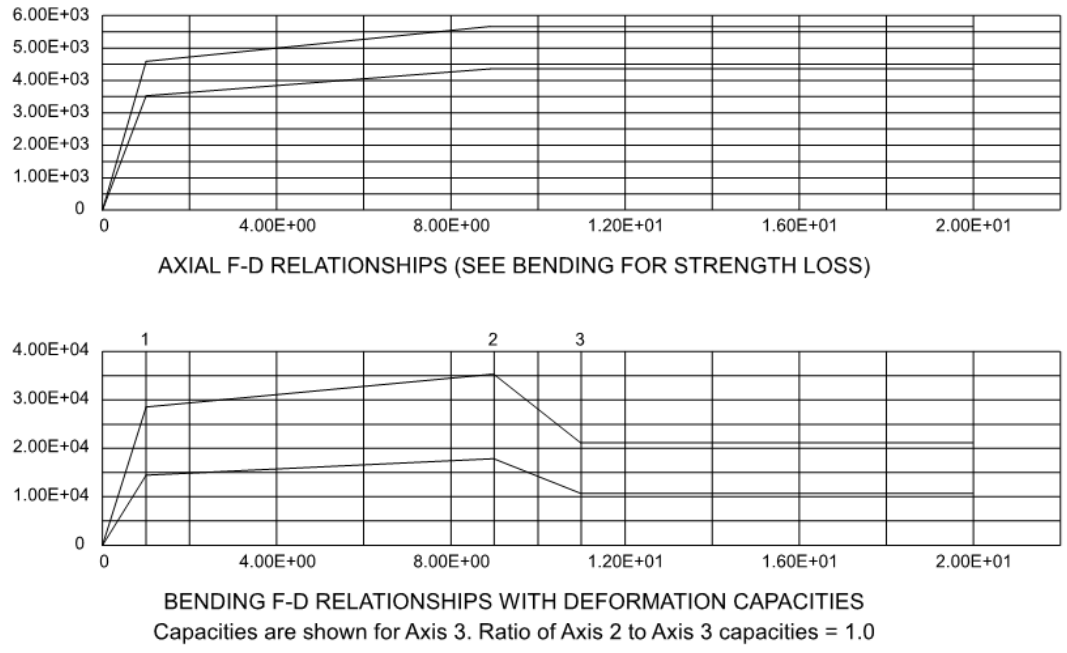


Figure 10- Deformation Capacities for Col. W 14X283

Panel Zone

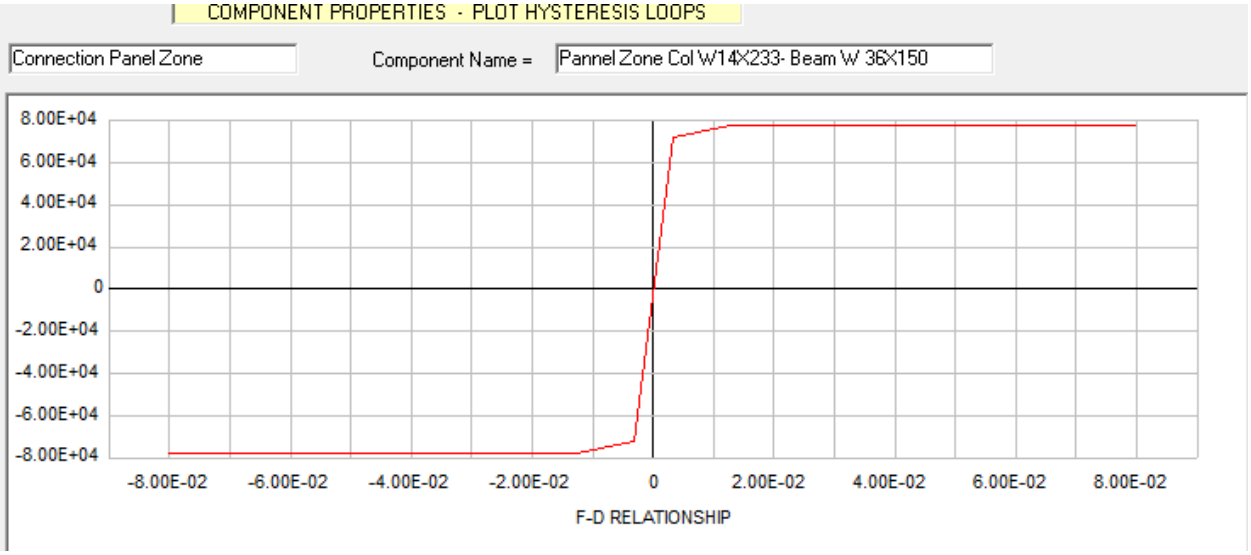


Figure 11- Deformation Capacities for Col. W 14X233-Beam W36X150

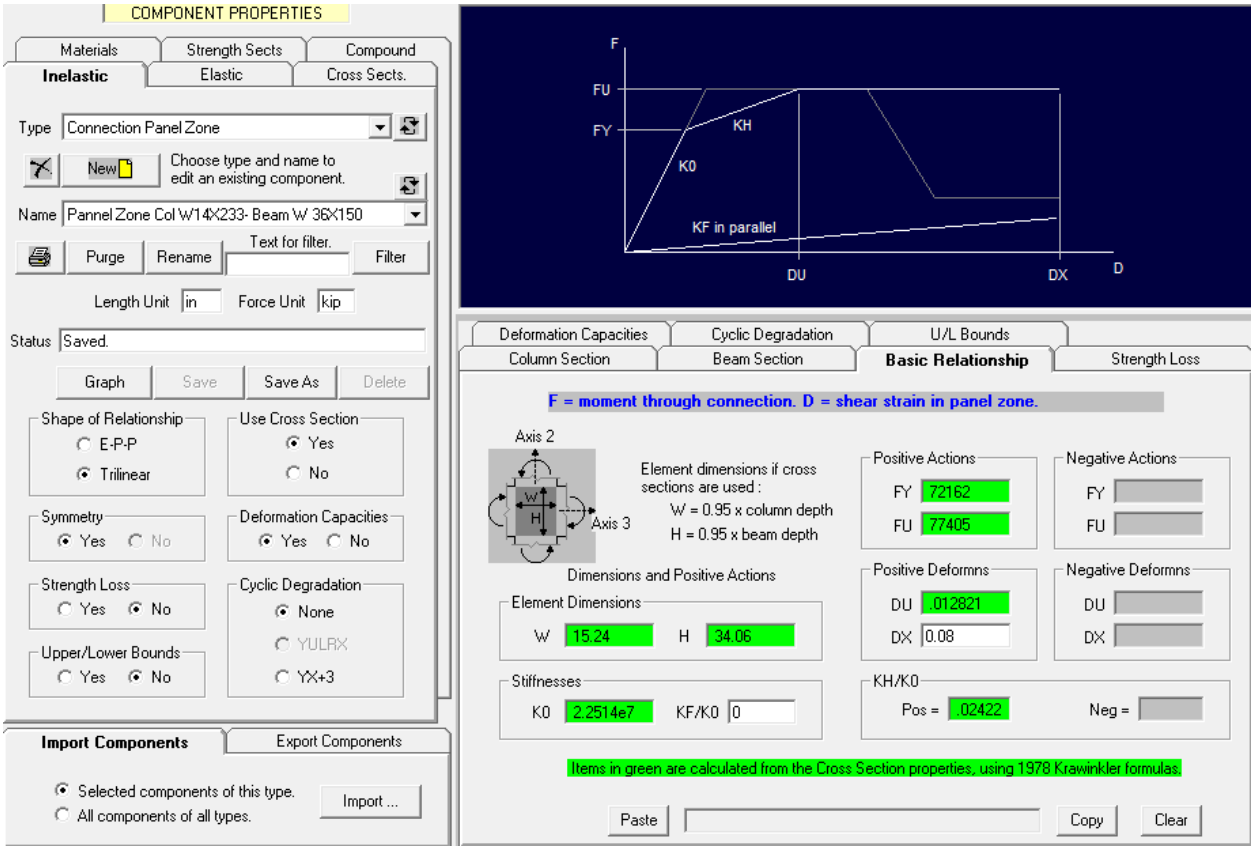


Figure 12-Basic Relationship Panel Zone for Col. W 14X233-Beam W36X150

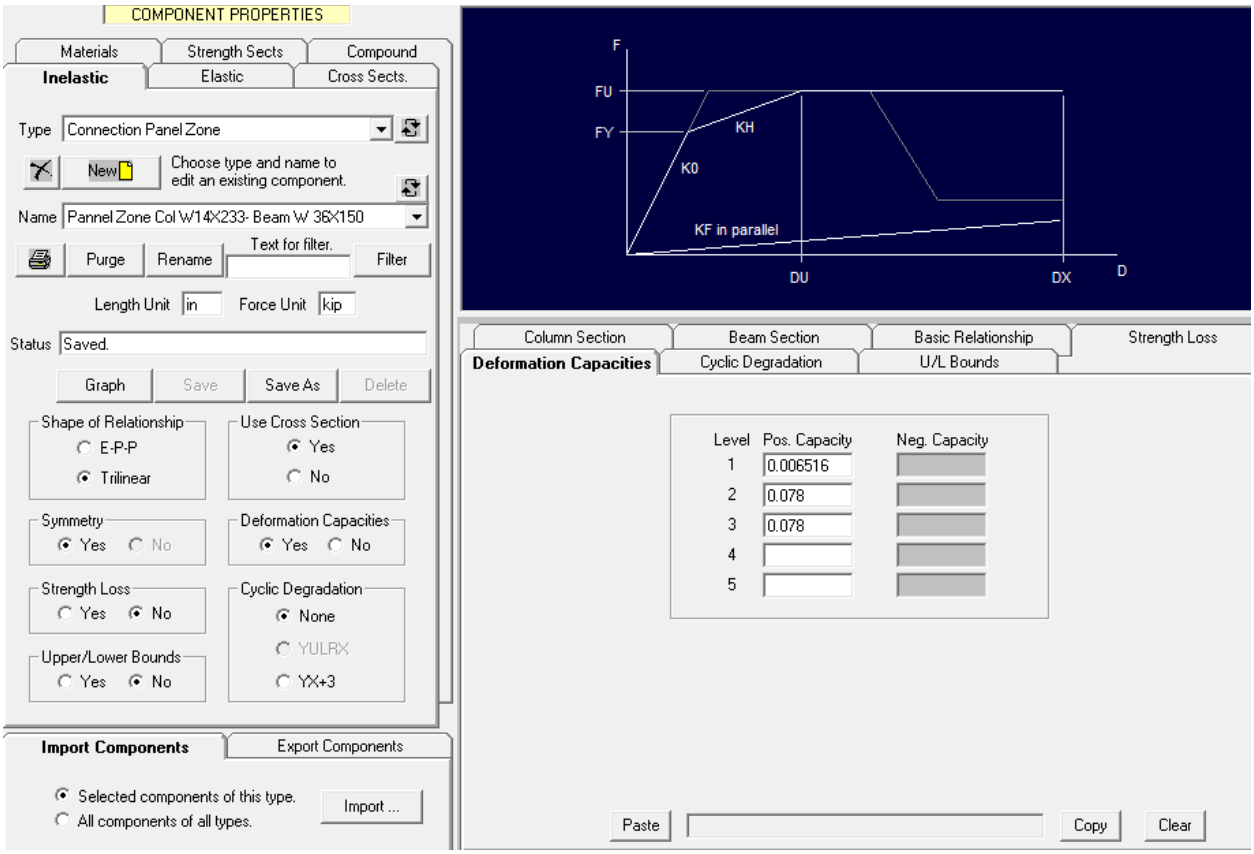
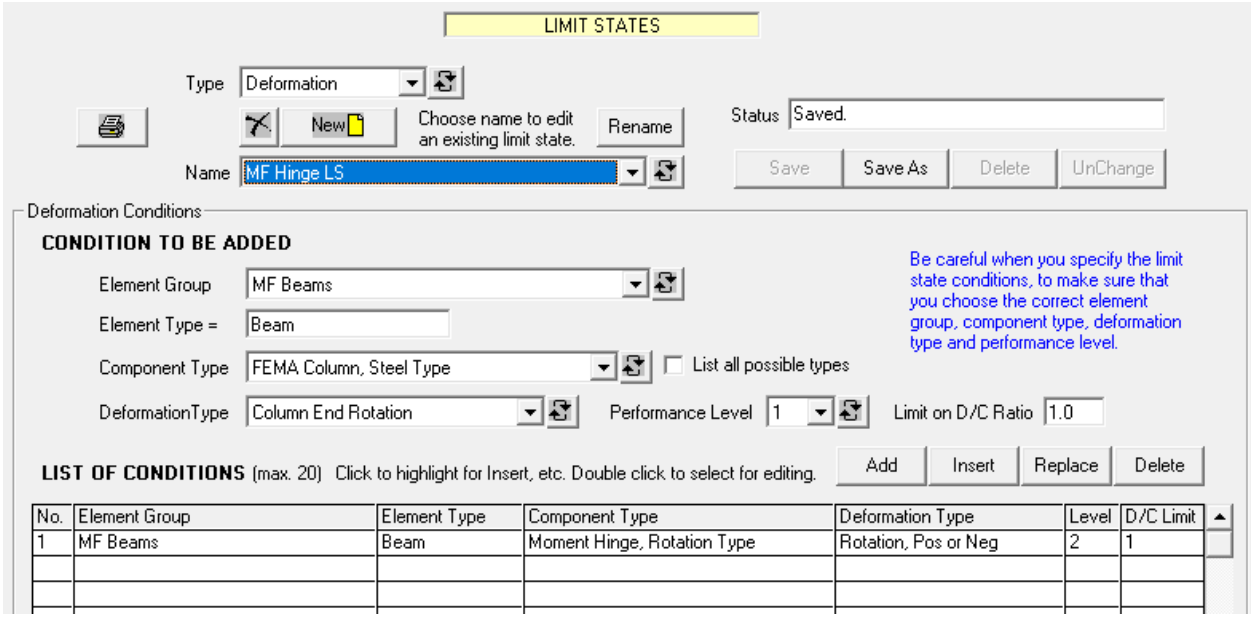
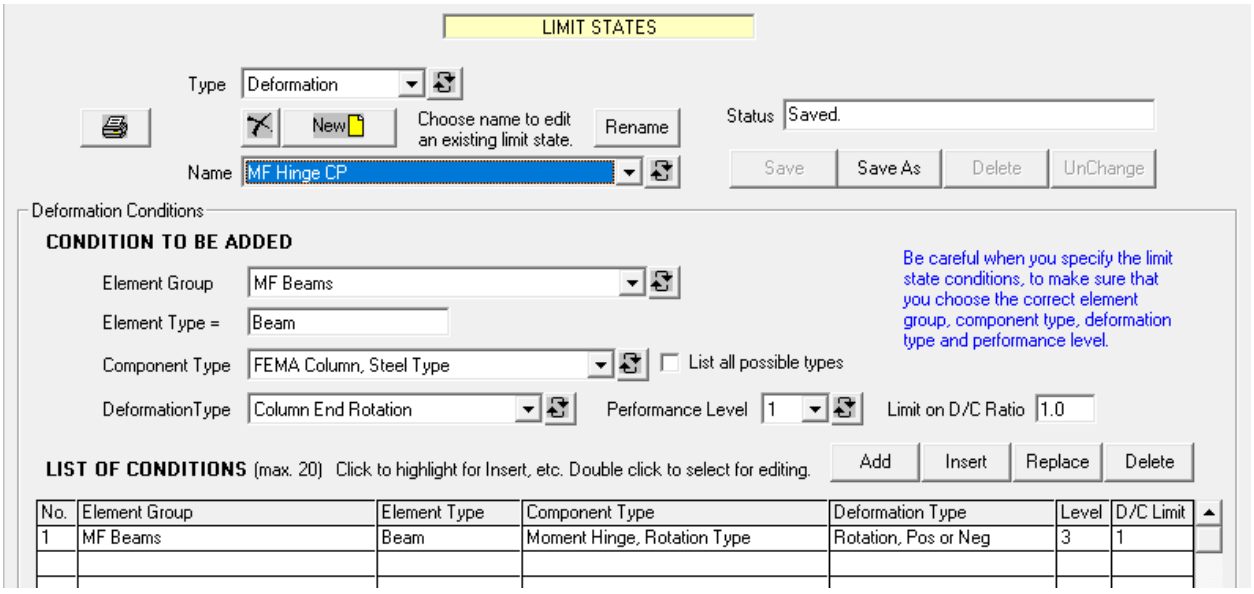


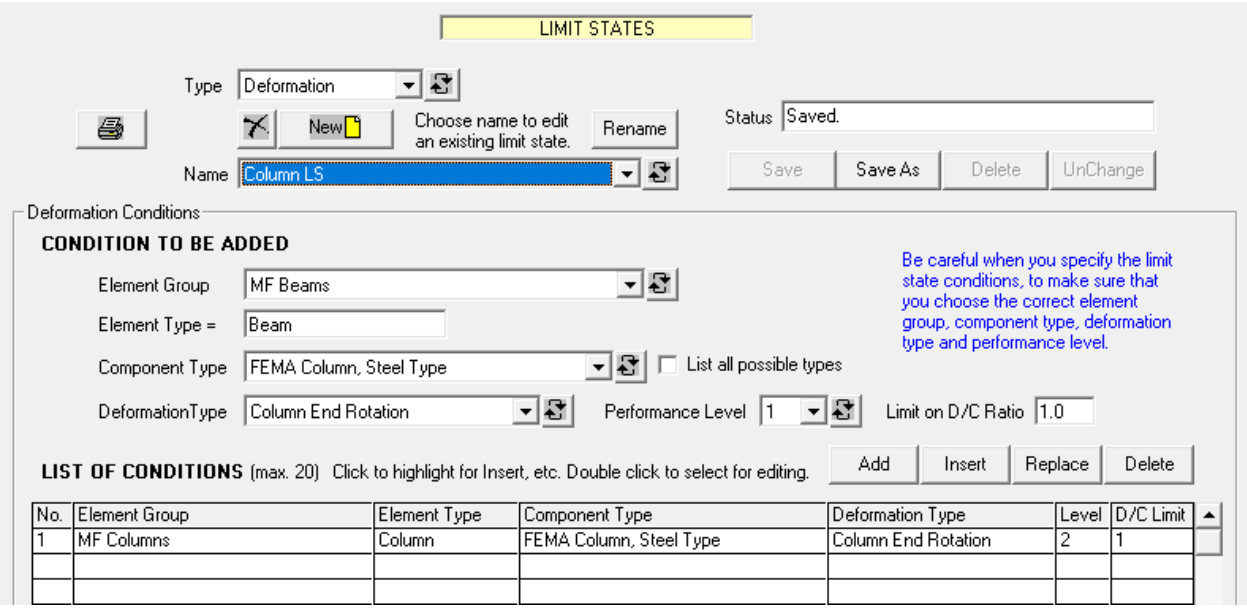
Figure 13-Deformation Capacities for Col. W 14X233-Beam W36X150

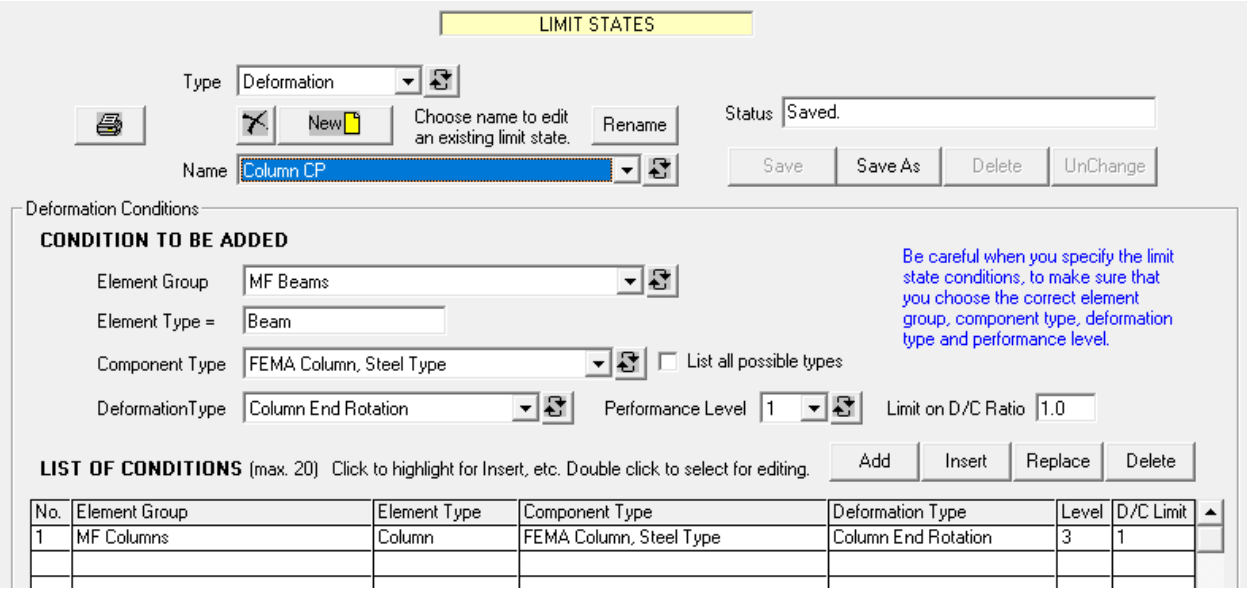
Limit States for Beam



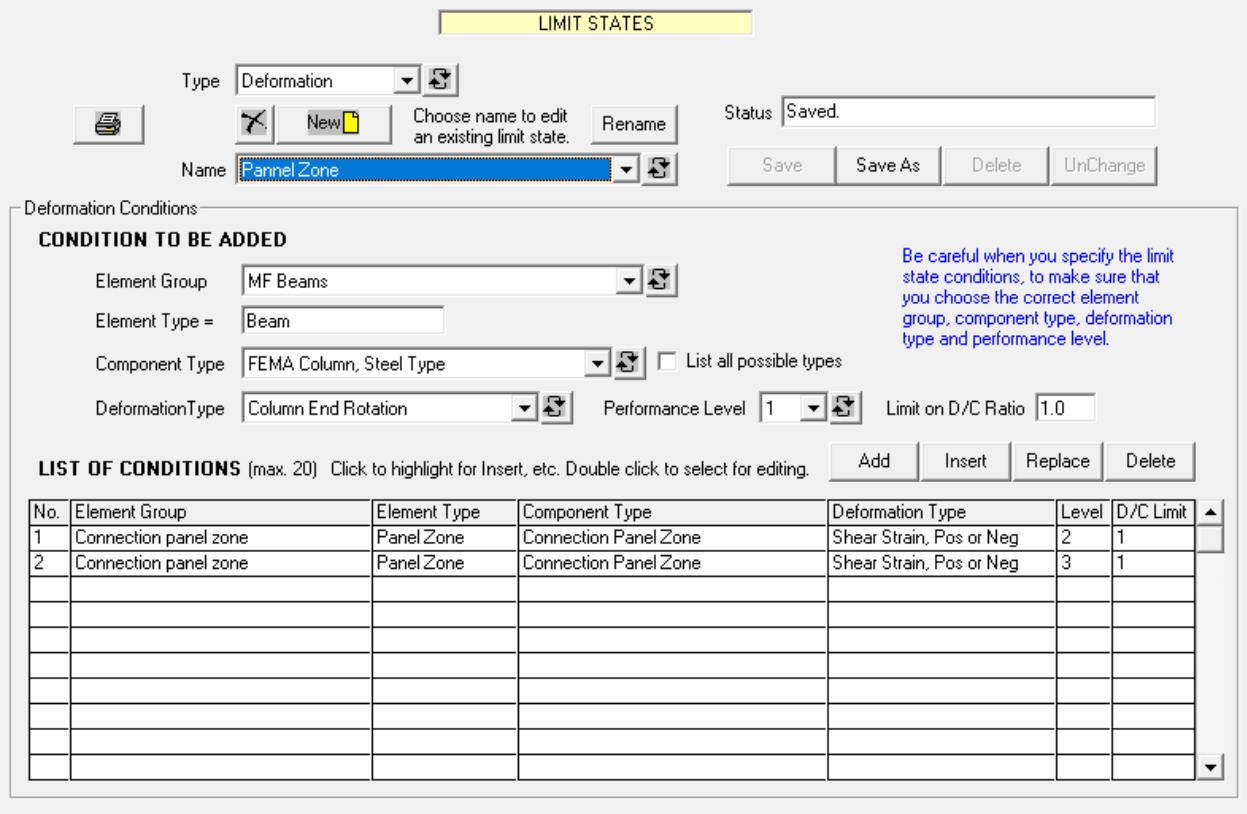


Limit States for column





Limit State for Panel Zone



Seismic Evaluation of Existing Building Via NSP

1. Seismic criteria

T_L	8	*sec*
Site Class	D	

BSE-2E			**BSE-1E**		
S_S	1.426	*g*	S_S	0.707	*g*
S_1	0.516	*g*	S_1	0.256	*g*
S_{XS}	1.426	*g*	S_{XS}	0.872	*g*
S_{X1}	0.774	*g*	S_{X1}	0.484	*g*
f_a	1.000		F_a	1.235	
f_v	1.500		F_v	1.887	

2. Target Displacement

Pushover	Target Disp.	150% Target Disp.	Governing LS Loc.	Governing LS Type
H1 Positive	0.01468	0.02202	0.01093	Deformation
H2 Positive	0.01415	0.02123	0.00992	Deformation
H1 Negative	0.01469	0.02204	0.01105	Deformation
H2 Negative	0.01414	0.02121	0.00986	Deformation

Modeling Criteria

CRITERIA:

Rigid End Zones: Include Effects: 50.00% Reduction
Member Force Output: At Face of Joint
P-Delta: Yes Scale Factor: 1.00
Ground Level: Base
Mesh Criteria :
Max. Distance Between Nodes on Mesh Line (ft) : 4.00
Merge Node Tolerance (in) : 0.0100
Geometry Tolerance (in) : 0.0050
Walls Out-of-plane Stiffness Included in Analysis.
Use Reduced Stiffness for Steel Members (AISC 360): $\tau b = 1.00$
Sign considered for Dynamic Load Case Results.
Rigid Links Included at Fixed Beam-to-Wall Locations
Eigenvalue Analysis : Eigen Vectors (Subspace Iteration)

DIAPHRAGM DATA:

Story	Diaph #	Diaph Type
Roof	1	Rigid
3rd	1	Rigid
2nd	1	Rigid

Disconnect Internal Nodes of Beams: Yes
Disconnect Nodes outside Slab Boundary: Yes

STORY MASS DATA:

Includes Self Mass of:

Beams
Columns (Half mass of columns above and below)
Walls (Half mass of walls above and below)
Slabs/Deck

LL = 50 psf

Calculated Values:

Story	Diaph #	Weight kips	Mass k-s2/ft	MMI ft-k-s2	Xm ft	Ym ft	EccX ft	EccY ft
Roof	1	680.06	21.12	39023	66.25	77.50	4.60	6.45
3rd	1	936.38	29.08	61847	64.56	70.99	5.07	7.05
2nd	1	987.87	30.68	68031	62.86	69.12	5.45	7.05

Story	Diaph #	Combine
Roof	1	None
3rd	1	None
2nd	1	None

DL+0.25LL
Roof : 1.886 [K-s^2/in]
3rd : 2.802 [K-s^2/in]
2nd : 2.936 [K-s^2/in]

WIND EXPOSURE DATA:

Calculated Values:

Story	Diaph #	Building Extents (ft)	Expose	Parapet

Applied Force at first level = 1st LVL Load - 2nd LVL load
For the Moment Frame Columns the distributed loads from beams are excluded.
Units Kips

Applied Force at second level = 2nd LVL Load - 3rd LVL load
For the Moment Frame Columns the distributed loads from beams are excluded.
Units Kips

	1st Floor					2nd Floor					3rd Floor			
Column	DL	LL	DL+0.25LL	Applied Load		DL	LL	DL+0.25LL	Applied Load		DL	LL	DL+0.25LL	
C-19	25.79	15.99	29.79	29.79		0.00	0.00	0.00	0.00		0.00	0.00	0.00	
C-20	45.28	26.86	52.00	12.95		34.14	19.61	39.04	39.04		0.00	0.00	0.00	
C-21	64.95	40.13	74.98	35.48		34.57	19.72	39.50	39.50		0.00	0.00	0.00	
C-22	42.73	24.89	48.95	21.86		23.76	13.32	27.09	27.09		0.00	0.00	0.00	
E-18	34.39	21.04	39.65	23.75		13.86	8.18	15.91	15.91		0.00	0.00	0.00	
E-19	179.73	94.08	203.25	65.22	F1	111.28	53.07	124.55	83.10	F1	37.59	10.43	27.97	F1
E-21	191.02	99.96	216.01	67.18	F1	121.19	56.63	135.35	84.59	F1	46.22	13.15	37.28	F1
E-22	91.97	51.25	104.78	39.27		58.13	29.55	65.52	42.29		21.52	6.82	23.23	
G-18	103.00	50.58	115.65	28.80	F3	56.24	23.90	62.22	25.18	F3	23.47	5.24	12.41	F3
G-19	172.21	96.78	196.41	74.24		108.54	54.50	122.17	68.17		50.04	15.82	54.00	
G-21	188.90	105.84	215.36	77.75		122.18	61.74	137.62	77.52		55.69	17.64	60.10	
G-22	96.58	46.11	108.11	22.86	F2	61.40	26.41	68.00	33.73	F2	28.49	7.31	17.03	F2
G.8-17	8.67	5.47	10.04	10.04		0.00	0.00	0.00	0.00		0.00	0.00	0.00	
J-17	5.24	3.19	6.04	6.04		0.00	0.00	0.00	0.00		0.00	0.00	0.00	
J-18	134.25	69.80	151.70	28.94	F3	87.56	42.27	98.13	50.55	F3	32.86	9.85	22.95	F3
J-19	180.16	100.48	205.28	75.24		115.60	57.78	130.05	71.93		53.85	17.08	58.12	
J-21	188.59	105.84	215.05	77.57		122.05	61.74	137.49	77.35		55.73	17.64	60.14	
J-22	117.54	58.04	132.05	29.77	F2	76.45	34.35	85.04	44.26	F2	34.31	10.05	23.53	F2
M-18	54.24	29.97	61.73	4.20		53.16	17.49	57.53	40.11		16.17	5.00	17.42	
M-19	172.27	88.37	194.36	58.18	F4	111.25	51.59	124.15	67.04	F4	50.66	14.76	45.08	F4
M-21	190.30	100.10	215.33	65.93	F4	122.78	58.33	137.36	74.70	F4	55.76	16.55	50.62	F4
M-22	81.70	46.50	93.33	33.63		52.92	27.12	59.70	33.52		24.24	7.75	26.18	
P-18.7	28.42	14.46	32.04	11.48		18.45	8.44	20.56	11.38		8.58	2.41	9.18	
P-19	61.33	33.92	69.81	25.13		39.73	19.79	44.68	25.02		18.25	5.65	19.66	
P-21	92.68	51.19	105.48	37.97		60.04	29.88	67.51	37.62		27.74	8.61	29.89	
P-22	77.24	42.32	87.82	31.59		50.06	24.69	56.23	31.43		23.03	7.08	24.80	

Calculation:
[A_trib._Beam/A_floor]*FloorLoad/Length_beam

MF Beam	Trib.Area (ft^2)	Length (in)	1st Floor Uniform Load(KPf)	2nd Floor Uniform Load(KPf)	3rd Floor Uniform Load(KPf)
B-1	317.3	408	0.0753	0.0718	0.0600
B-2	406	336	0.1169	0.1116	0.0791
B-3	579.875	336	0.1670	0.1594	0.0737
B-4	283.33	408	0.0672	0.0641	0.0455

52/(Fye)^0.5 = 7.35
418/(Fye)^0.5 = 59.11

Beam W36X194
bf/2tf = 4.18
h/tw = 42.2
Beam W36X150
bf/2tf = 6.37
h/tw = 51.9

Table 9-6. Modeling Parameters and Acceptance Criteria for Nonlinear Procedures—Structural Steel Components

Component or Action	Modeling Parameters: Plastic Rotation Angle, Radians *a*	Modeling Parameters: Plastic Rotation Angle, Radians *b*	Modeling Parameters: Residual Strength Ratio *c*	Acceptance Criteria: Plastic Rotation Angle, Radians IO	Acceptance Criteria: Plastic Rotation Angle, Radians LS	Acceptance Criteria: Plastic Rotation Angle, Radians CP
Beams—Flexure						
a. $\frac{b_f}{2t_f} \le \frac{52}{\sqrt{F_{ye}}}$ and $\frac{h}{t_w} \le \frac{418}{\sqrt{F_{ye}}}$	$9\theta_y$	$11\theta_y$	0.6	$1\theta_y$	$9\theta_y$	$11\theta_y$
b. $\frac{b_f}{2t_f} \ge \frac{65}{\sqrt{F_{ye}}}$ or $\frac{h}{t_w} \ge \frac{640}{\sqrt{F_{ye}}}$	$4\theta_y$	$6\theta_y$	0.2	$0.25\theta_y$	$3\theta_y$	$4\theta_y$
c. Other	Linear interpolation between the values on lines a and b for both flange slenderness (first term) and web slenderness (second term) shall be performed, and the lower resulting value shall be used					
Columns—Flexure[a,b]						
For $P/P_{CL} < 0.2$						
a. $\frac{b_f}{2t_f} \le \frac{52}{\sqrt{F_{ye}}}$ and $\frac{h}{t_w} \le \frac{300}{\sqrt{F_{ye}}}$	$9\theta_y$	$11\theta_y$	0.6	$1\theta_y$	$9\theta_y$	$11\theta_y$
b. $\frac{b_f}{2t_f} \ge \frac{65}{\sqrt{F_{ye}}}$ or $\frac{h}{t_w} \ge \frac{460}{\sqrt{F_{ye}}}$	$4\theta_y$	$6\theta_y$	0.2	$0.25\theta_y$	$3\theta_y$	$4\theta_y$
c. Other	Linear interpolation between the values on lines a and b for both flange slenderness (first term) and web slenderness (second term) shall be performed, and the lower resulting value shall be used					
For $0.2 \le P/P_{CL} \le 0.5$						
a. $\frac{b_f}{2t_f} \le \frac{52}{\sqrt{F_{ye}}}$ and $\frac{h}{t_w} \le \frac{260}{\sqrt{F_{ye}}}$	—[c]	—[d]	0.2	$0.25\theta_y$	—[e]	—[d]
b. $\frac{b_f}{2t_f} \ge \frac{65}{\sqrt{F_{ye}}}$ or $\frac{h}{t_w} \ge \frac{400}{\sqrt{F_{ye}}}$	$1\theta_y$	$1.5\theta_y$	0.2	$0.25\theta_y$	$1.2\theta_y$	$1.2\theta_y$
c. Other	Linear interpolation between the values on lines a and b for both flange slenderness (first term) and web slenderness (second term) shall be performed, and the lower resulting value shall be used					
Column Panel Zones	$12\theta_y$	$12\theta_y$	1.0	$1\theta_y$	$12\theta_y$	$12\theta_y$
Fully Restrained Moment Connections[f]						
WUF[g]	0.051–0.0013*d*	0.043–0.00060*d*	0.2	0.026–0.00065*d*	0.0323–0.00045*d*	0.043–0.00060*d*
Bottom haunch in WUF with slab	0.026	0.036	0.2	0.013	0.0270	0.036
Bottom haunch in WUF without slab	0.018	0.023	0.2	0.009	0.0180	0.023
Welded cover plate in WUF[g]	0.056–0.0011*d*	0.056–0.0011*d*	0.2	0.028–0.00055*d*	0.0420–0.00083*d*	0.056–0.0011*d*
Improved WUF—Bolted web[g]	0.021–0.00030*d*	0.050–0.00060*d*	0.2	0.010–0.00015*d*	0.0375–0.00045*d*	0.050–0.00060*d*
Improved WUF—Welded web	0.041	0.054	0.2	0.020	0.0410	0.054
Free flange[g]	0.067–0.0012*d*	0.094–0.0016*d*	0.2	0.034–0.00060*d*	0.0705–0.0012*d*	0.094–0.0016*d*
Reduced beam section[g]	0.050–0.00030*d*	0.070–0.00030*d*	0.2	0.025–0.00015*d*	0.0525–0.00023*d*	0.07–0.00030*d*
Welded flange plates						
a. Flange plate net section	0.03	0.06	0.2	0.015	0.0450	0.06
b. Other limit states	Force controlled					
Welded bottom haunch	0.027	0.047	0.2	0.014	0.0353	0.047
Welded top and bottom haunches	0.028	0.048	0.2	0.014	0.0360	0.048
Welded cover—plated flanges	0.031	0.031	0.2	0.016	0.0233	0.031
Partially Restrained Moment Connections						
Top and bottom clip angle[h]						
a. Shear failure of rivet or bolt (Limit State 1)[i]	0.036	0.048	0.200	0.008	0.030	0.040
b. Tension failure of horizontal leg of angle (Limit State 2)	0.012	0.018	0.800	0.003	0.010	0.015
c. Tension failure of rivet or bolt (Limit State 3)[i]	0.016	0.025	1.000	0.005	0.020	0.020
d. Flexural failure of angle (Limit State 4)	0.042	0.084	0.200	0.010	0.035	0.070
Double Split Tee[h]						
a. Shear failure of rivet or bolt (Limit State 1)[i]	0.036	0.048	0.200	0.008	0.030	0.040
b. Tension failure of rivet or bolt (Limit State 2)[i]	0.016	0.024	0.800	0.005	0.020	0.020
c. Tension failure of split Tee stem (Limit State 3)	0.012	0.018	0.800	0.003	0.010	0.015
d. Flexural failure of split Tee (Limit State 4)	0.042	0.084	0.200	0.010	0.035	0.070
Bolted Flange Plate[h]						
a. Failure in net section of flange plate or shear failure of bolts or rivets[i]	0.030	0.030	0.800	0.008	0.020	0.025

52/(Fye)^0.5 = 7.35
300/(Fye)^0.5 = 42.43
Column W14X283
bf/2tf = 3.89
h/tw = 8.84
Column W14X233
bf/2tf = 4.62
h/tw = 10.7
P/Pcl = 0.12

Story level 2nd, Column Line 19-E, Column # 6

Fy (ksi)	= 50.00	Column Size	= W14X283
Orientation (deg.)	= 0.0		

INPUT DESIGN PARAMETERS:

		X-Axis	Y-Axis
Lu (ft)		15.50	15.50
K		1	1
Braced Against Joint Translation		Yes	Yes
Column Eccentricity (in)	Top	10.85	10.55
	Bottom	0.00	0.00

CONTROLLING AXIAL COLUMN LOADS - Skip-Load Case 1:

	Dead	Live	Roof
Axial (kip)	177.71	92.91	0.00

DEMAND CAPACITY RATIO: (1.2DL + 1.6LL)

Pu (kip)	= 361.91	0.90Pnx (kip)	= 3548.35	Pu/0.90Pnx	=	0.102
		0.90Pny (kip)	= 3238.23	Pu/0.90Pny	=	0.112
		0.90Pn (kip)	= 3238.23	Pu/0.90Pn	=	0.112

CONTROLLING COMBINED COLUMN LOADS - Skip-Load Case 17:

			Dead	Live	Roof
Axial (kip)			177.71	73.86	0.00
Moments	Top	Mx (kip-ft)	0.50	3.33	0.00
		My (kip-ft)	-1.45	-5.47	0.00
	Bot	Mx (kip-ft)	0.00	0.00	0.00
		My (kip-ft)	0.00	0.00	0.00

Single curvature about X-Axis
Single curvature about Y-Axis

CALCULATED PARAMETERS: (1.2DL + 1.6LL)

Pu (kip)	=	331.43	0.90*Pn (kip)	=	3238.23
Mux (kip-ft)	=	5.92	0.90*Mnx (kip-ft)	=	2032.50
Muy (kip-ft)	=	-10.49	0.90*Mny (kip-ft)	=	1027.50
Rm	=	1.00			
Cbx	=	1.67			
Cmx	=	0.60	Cmy	=	0.60
Pex (kip)	=	31768.97	Pey (kip)	=	11913.36
B1x	=	1.00	B1y	=	1.00

INTERACTION EQUATION

Pu/0.90*Pn = 0.102
Eq H1-1b: 0.051 + 0.003 + 0.010 = 0.064

Target Displacement Analysis

PUSH-OVER RESULTS, TARGET DISPLACEMENT METHOD

Structure = EglProject (Pushover of Steel Moment Frame)

Analysis Series = Series 2 (Push over)

Load Case = [2] = [1] + H1, PushOver Linear

Limit state group = all deformation limit states

SEE NEXT PAGE FOR LIMIT STATE LIST

Elastic Spectrum : SXS = 0.872g, SX1 = 0.484g, BS = 1, B1 = 1, T0 = .55505 sec.

Framing Type = Type 1, Performance Level = LS.

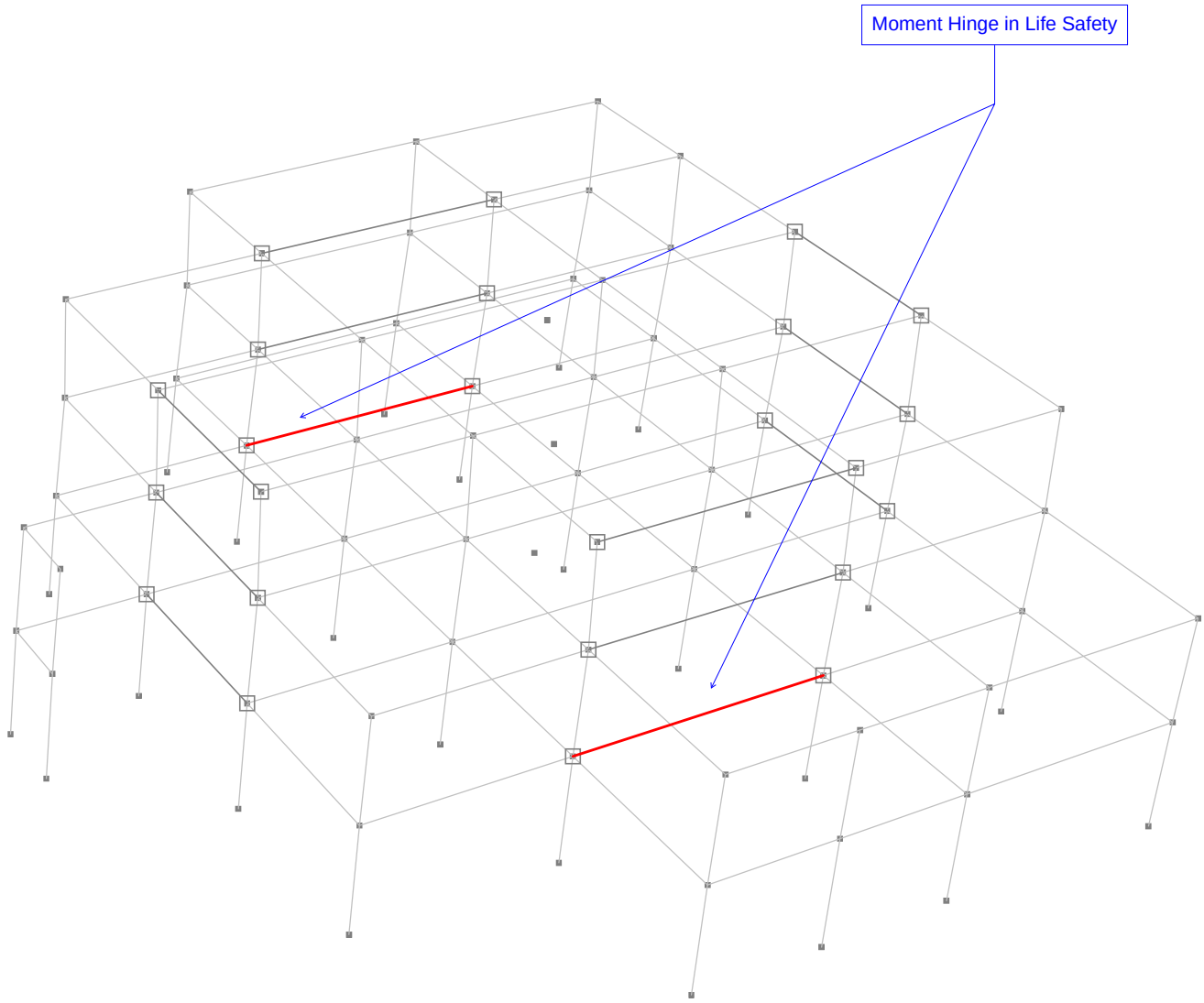
C0 = 1.2 (user value).

C1 = 1 (from FEMA-356 formula). Te (sec) = .8365, Sa = .5786g, Cm = .8681, Ratio R = 1.096.

C2 = 1 (user value). C3 = 1 (user value).

Target Drift = .01468

Positive H1 Life Safety
Target Displacement



DEFLECTED SHAPE SHOWING ELEMENT USAGE RATIOS

Structure = EglProject (Pushover of Steel Moment Frame)

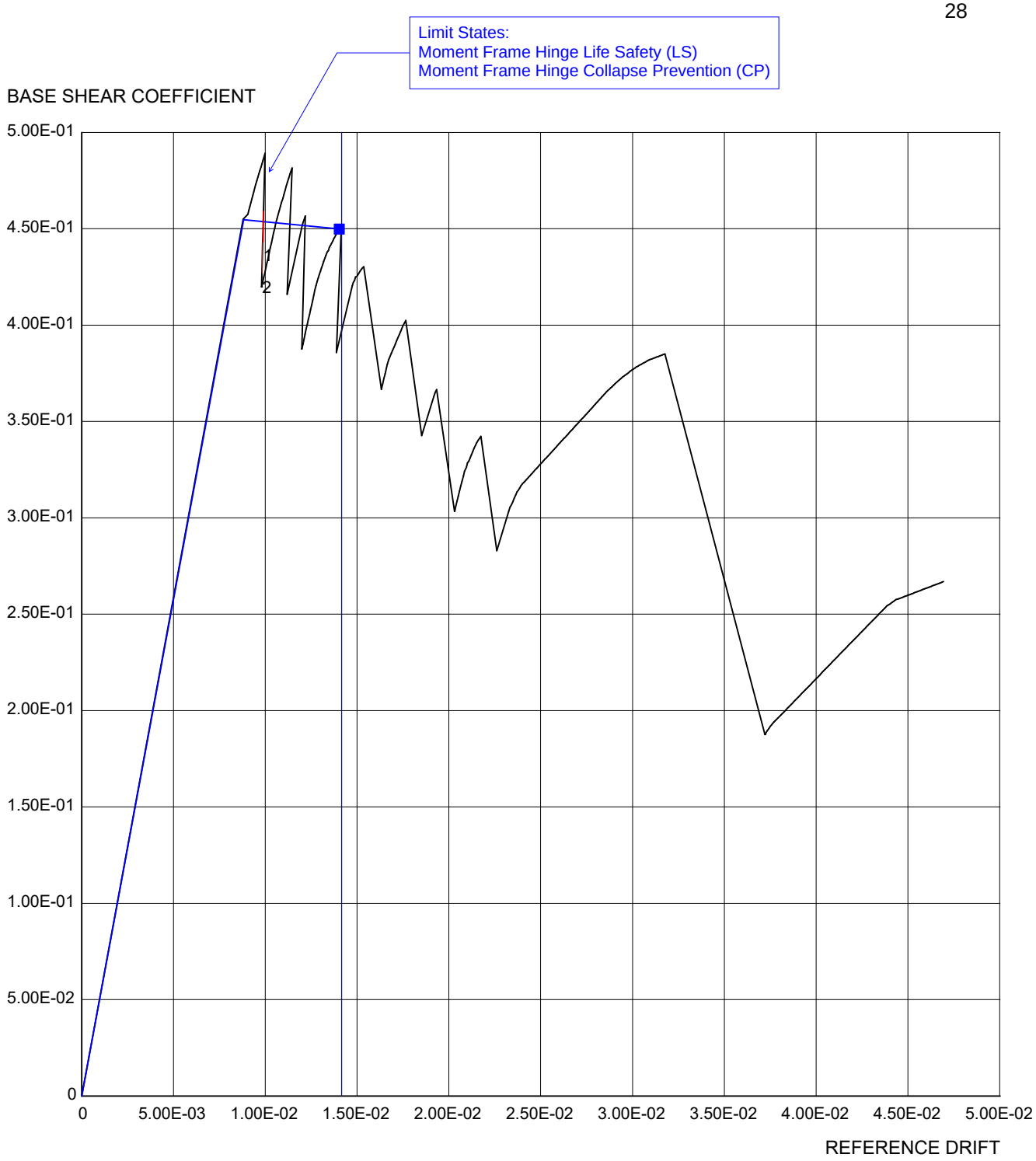
Analysis Series = Series 2 (Push over)

Load Case = [2] = [1] + H1, PushOver Linear

Reference Drift = .0145

Limit state group = all deformation states

Minimum usage ratio for each color : 0.0 0.7 0.8 0.9 1



PUSH-OVER RESULTS, TARGET DISPLACEMENT METHOD

Structure = EglProject (Pushover of Steel Moment Frame)

Analysis Series = Seris3 (Pushover F1, H2 direction)

Load Case = [2] = [1] + H2, Pushover Linear

Limit state group = all deformation limit states

SEE NEXT PAGE FOR LIMIT STATE LIST

Elastic Spectrum : SXS = 0.872g, SX1 = 0.484g, BS = 1, B1 = 1, T0 = .55505 sec.

Framing Type = Type 1, Performance Level = LS.

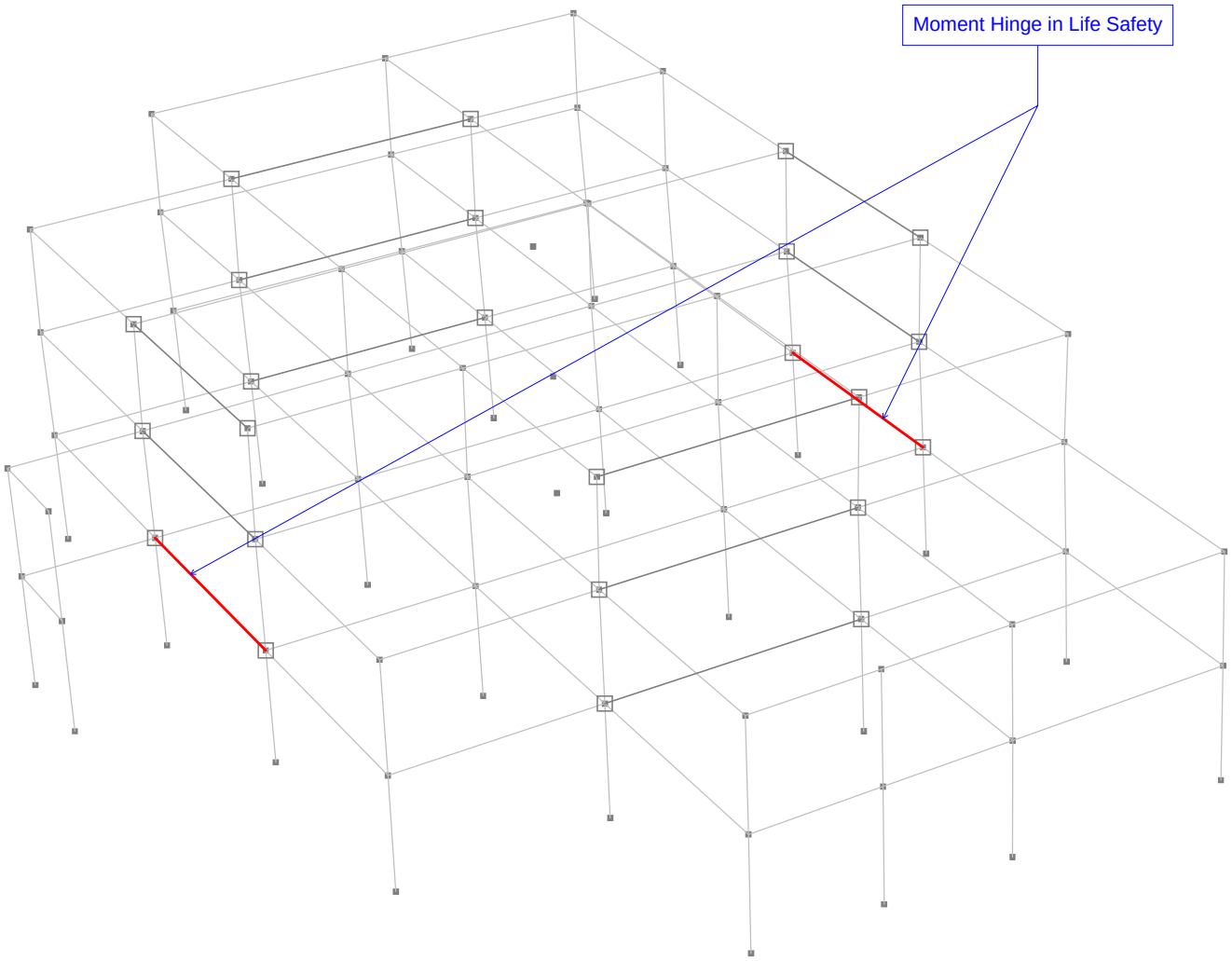
C0 = 1.2 (user value).

C1 = 1 (from FEMA-356 formula). Te (sec) = .8063, Sa = .6003g, Cm = .872, Ratio R = 1.151.

C2 = 1 (user value). C3 = 1 (user value).

Target Drift = .01415

Positive H2 Life Safety
Target Displacement



DEFLECTED SHAPE SHOWING ELEMENT USAGE RATIOS

Structure = EglProject (Pushover of Steel Moment Frame)

Analysis Series = Seris3 (Pushover F1, H2 direction)

Load Case = [2] = [1] + H2, Pushover Linear

Reference Drift = .01407

Limit state group = all deformation states

Minimum usage ratio for each color : 0.0 0.7 0.8 0.9 1

PUSH-OVER RESULTS, TARGET DISPLACEMENT METHOD

Structure = EglProject (Pushover of Steel Moment Frame)

Analysis Series = Series 1 (Pushover, -H1)

Load Case = [2] = [1] + Pushover, -H1

Limit state group = all deformation limit states

SEE NEXT PAGE FOR LIMIT STATE LIST

Elastic Spectrum : SXS = 0.872g, SX1 = 0.484g, BS = 1, B1 = 1, T0 = .55505 sec.

Framing Type = Type 1, Performance Level = LS.

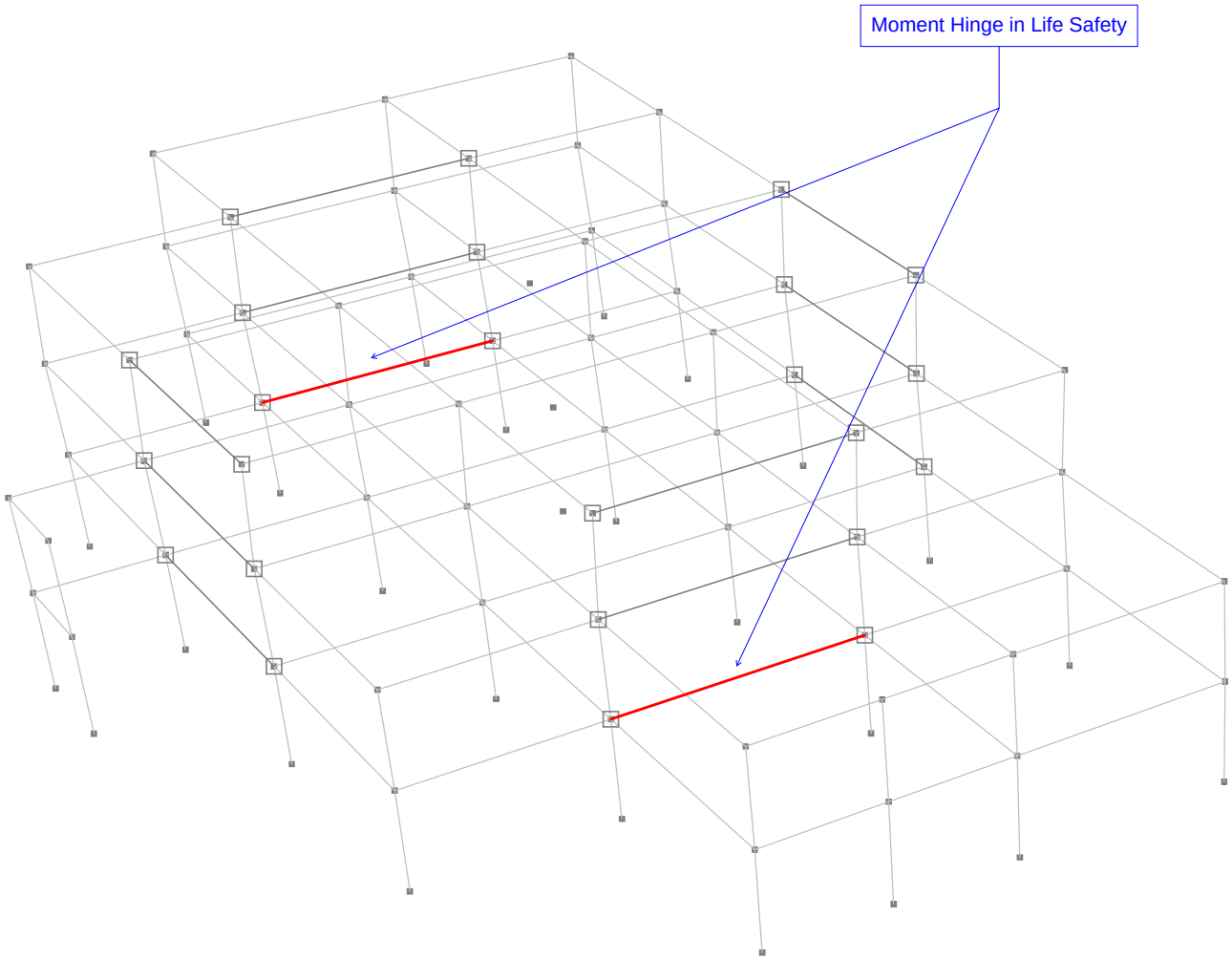
C0 = 1.2 (user value).

C1 = 1 (from FEMA-356 formula). Te (sec) = .8373, Sa = .578g, Cm = .8681, Ratio R = 1.094.

C2 = 1 (user value). C3 = 1 (user value).

Target Drift = .01469

Negative H1 Life Safety Target Displacement



DEFLECTED SHAPE SHOWING ELEMENT USAGE RATIOS

Structure = EglProject (Pushover of Steel Moment Frame)

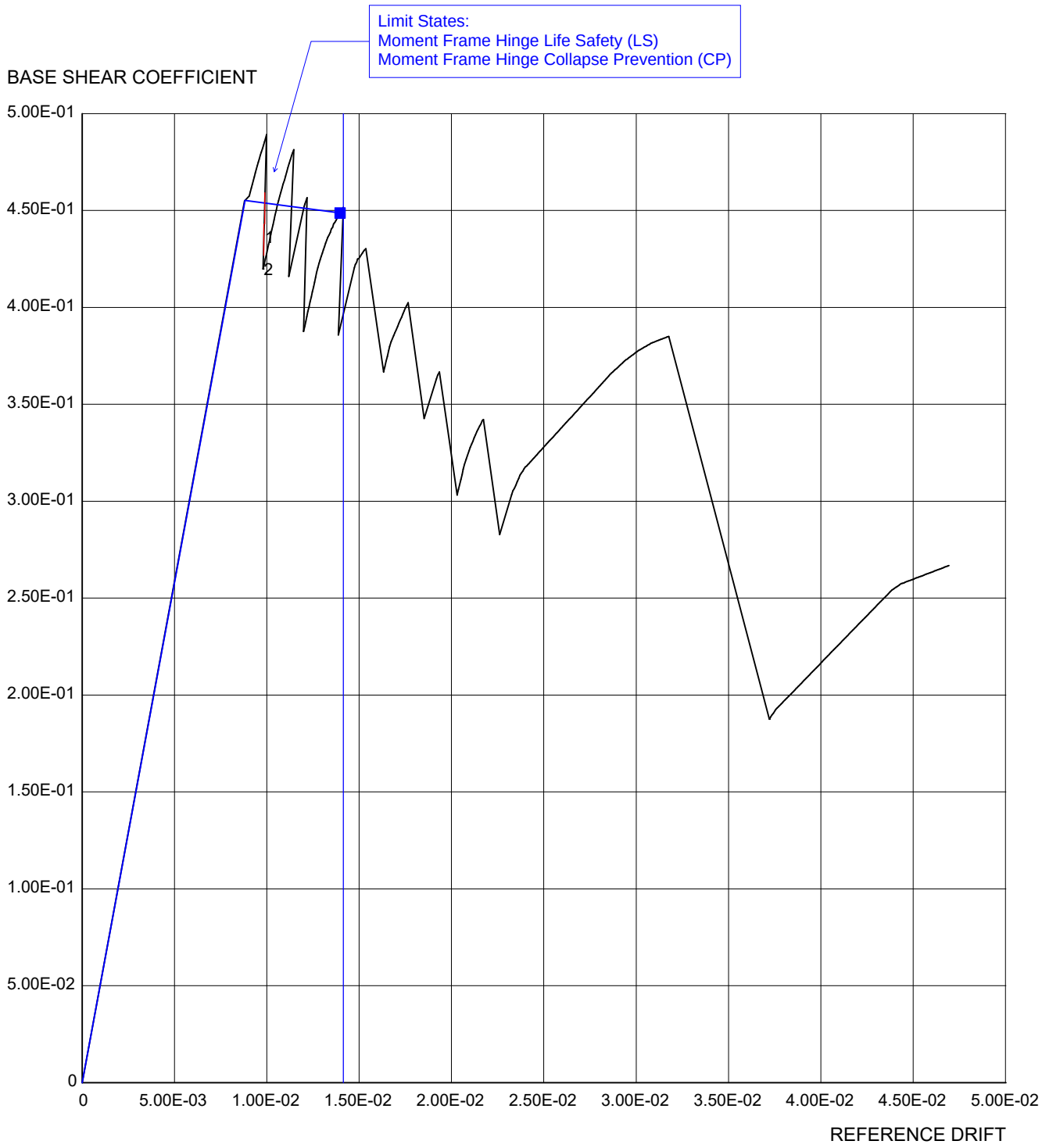
Analysis Series = Series 1 (Pushover, -H1)

Load Case = [2] = [1] + Pushover, -H1

Reference Drift = .01456

Limit state group = all deformation states

Minimum usage ratio for each color : 0.0 0.7 0.8 0.9 1



PUSH-OVER RESULTS, TARGET DISPLACEMENT METHOD

Structure = EglProject (Pushover of Steel Moment Frame)

Analysis Series = series 4 (Pushover, -H2)

Load Case = [2] = [1] + Pushover,-H2

Limit state group = all deformation limit states

SEE NEXT PAGE FOR LIMIT STATE LIST

Elastic Spectrum : SXS = 0.872g, SX1 = 0.484g, BS = 1, B1 = 1, T0 = .55505 sec.

Framing Type = Type 1, Performance Level = LS.

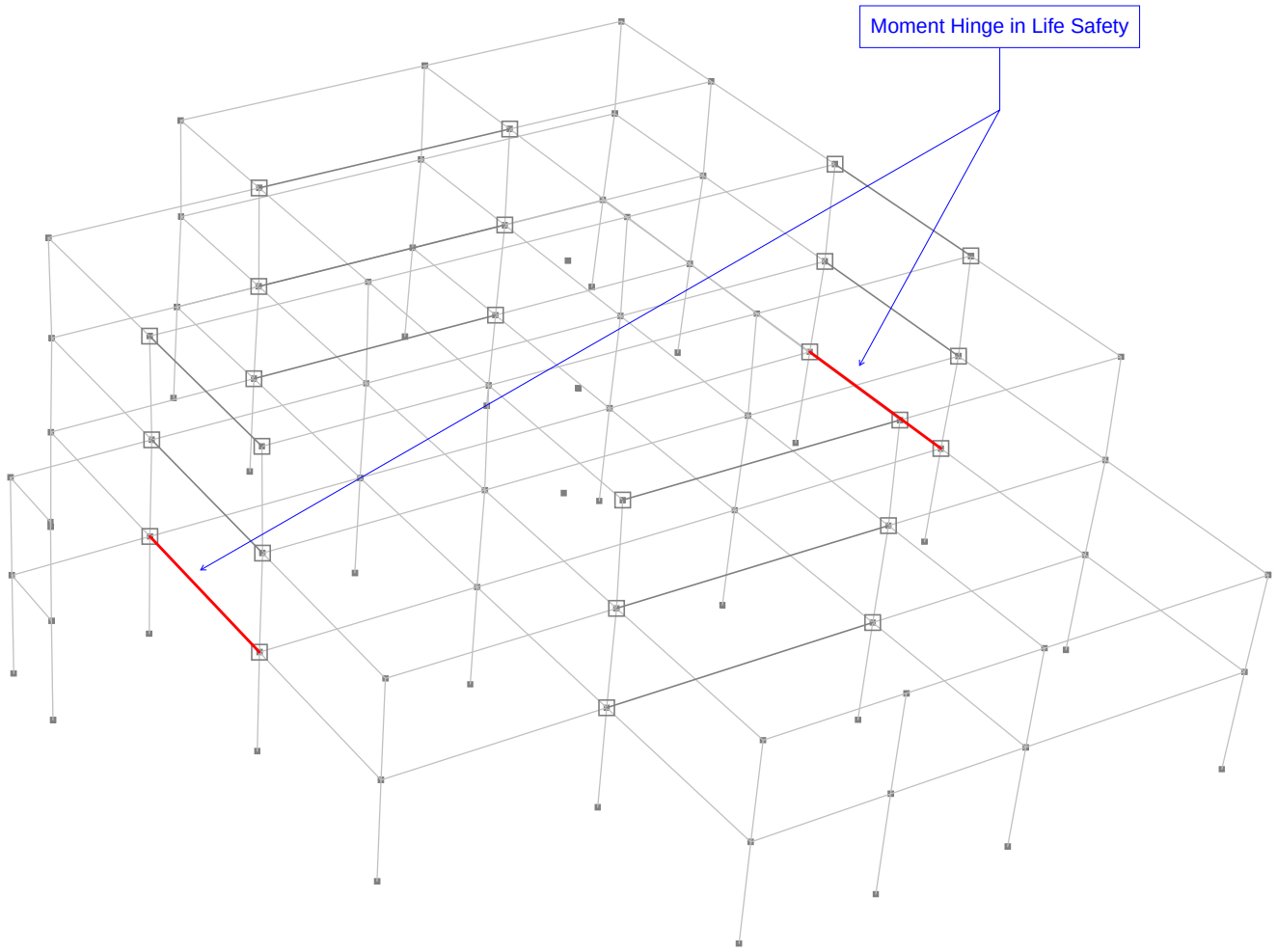
C0 = 1.2 (user value).

C1 = 1 (from FEMA-356 formula). Te (sec) = .8058, Sa = .6007g, Cm = .8721, Ratio R = 1.151.

C2 = 1 (user value). C3 = 1 (user value).

Target Drift = .01414

Negative H2 Life Safety Target Displacement



DEFLECTED SHAPE SHOWING ELEMENT USAGE RATIOS

Structure = EglProject (Pushover of Steel Moment Frame)

Analysis Series = series 4 (Pushover, -H2)

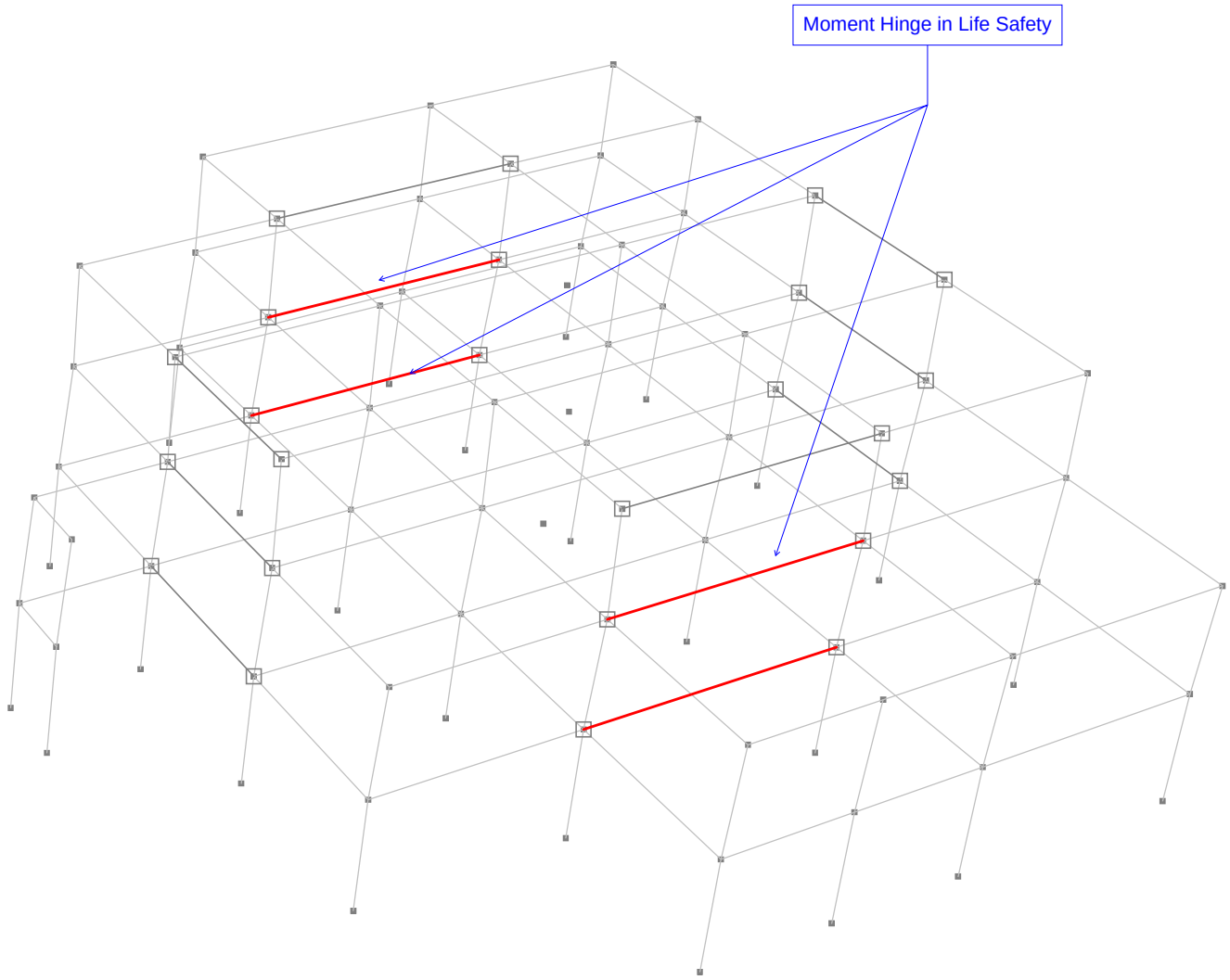
Load Case = [2] = [1] + Pushover,-H2

Reference Drift = .01407

Limit state group = all deformation states

Minimum usage ratio for each color : 0.0 0.7 0.8 0.9 1

Positive H1 Life Safety
150% Target
Displacement



DEFLECTED SHAPE SHOWING ELEMENT USAGE RATIOS

Structure = EglProject (Pushover of Steel Moment Frame)

Analysis Series = Series 2 (Push over)

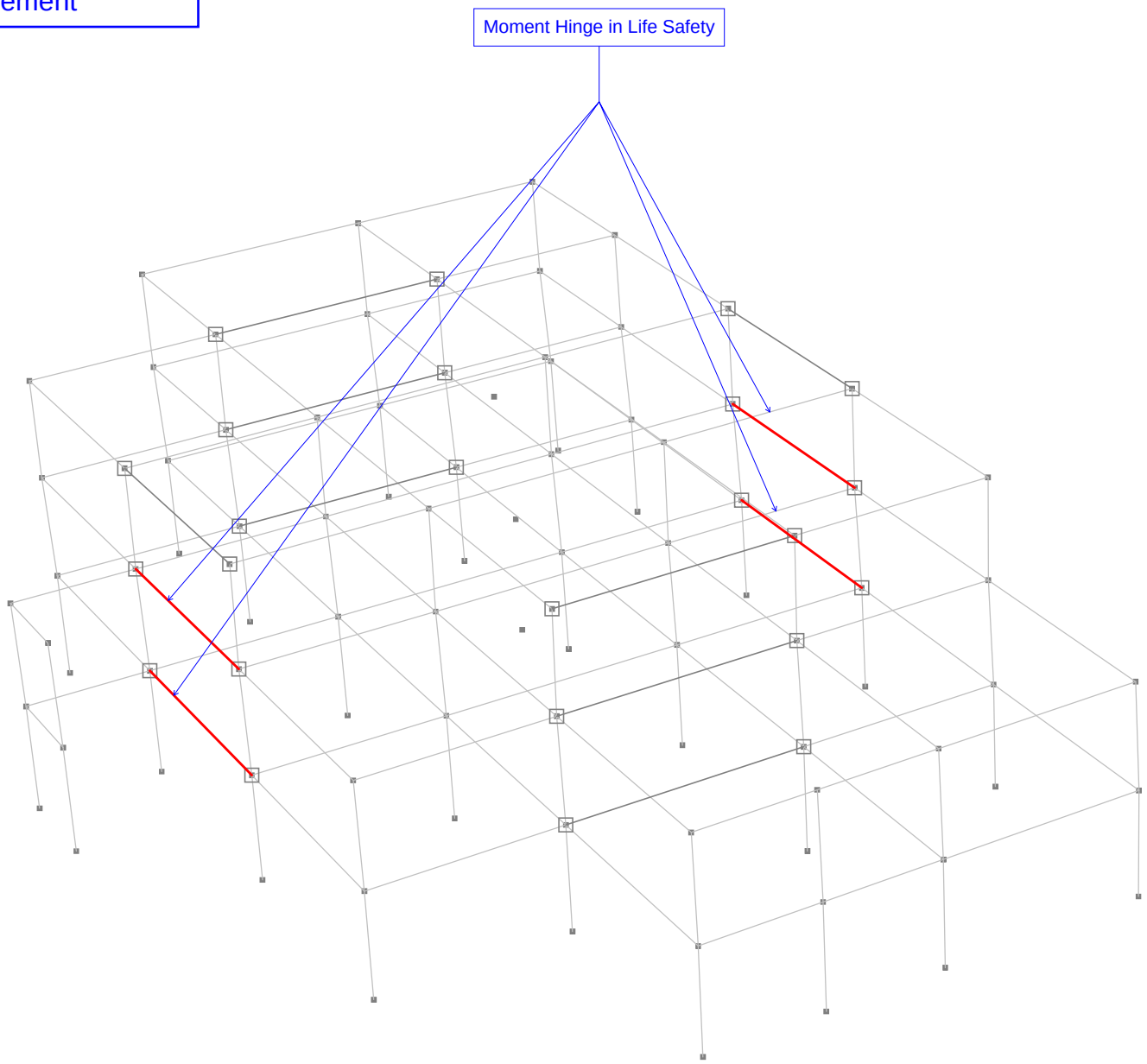
Load Case = [2] = [1] + H1, PushOver Linear

Reference Drift = .02126

Limit state group = all deformation states

Minimum usage ratio for each color : 0.0 0.7 0.8 0.9 1

Positive H2 Life Safety
150% Target
Displacement



DEFLECTED SHAPE SHOWING ELEMENT USAGE RATIOS

Structure = EglProject (Pushover of Steel Moment Frame)

Analysis Series = Seris3 (Pushover F1, H2 direction)

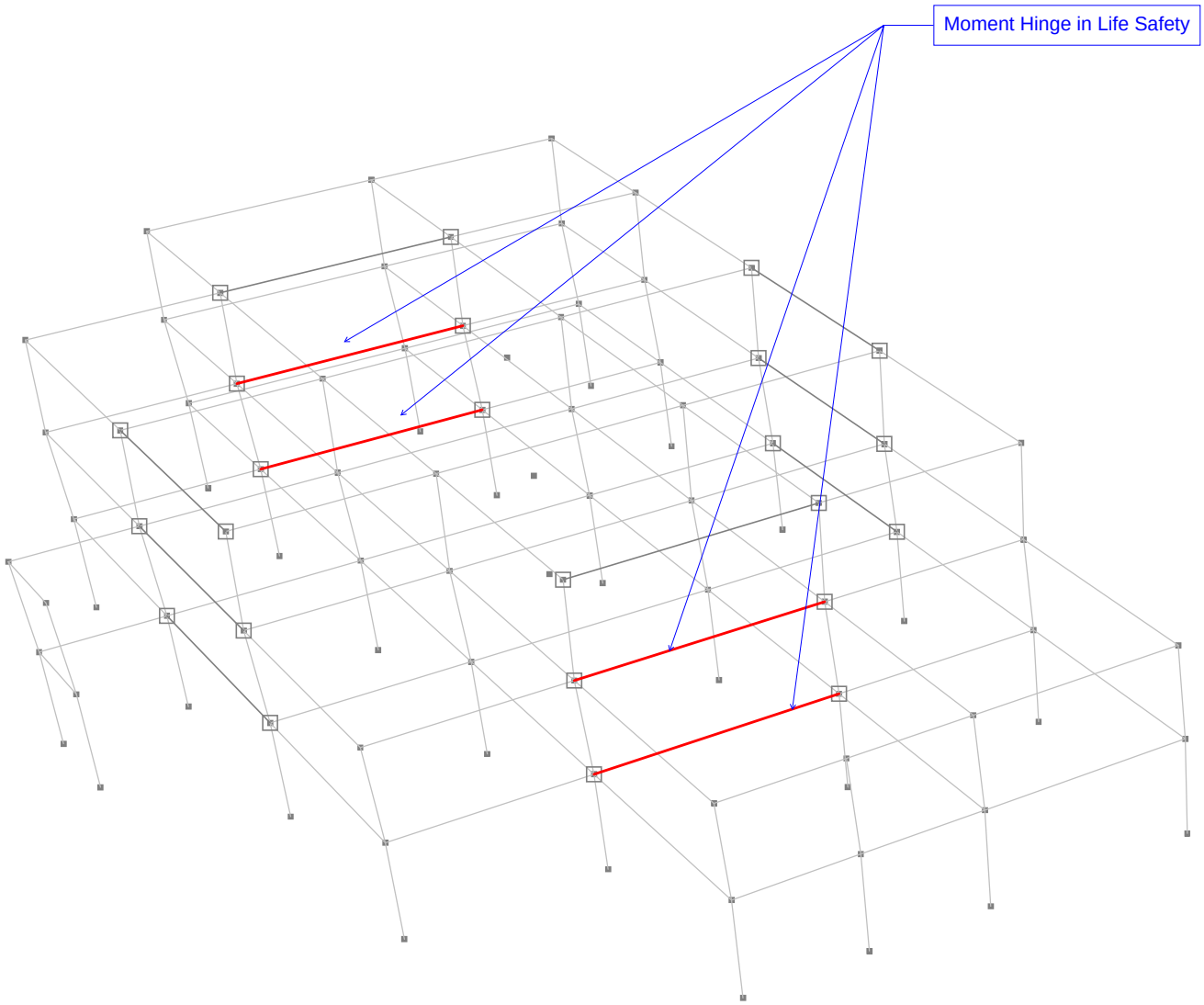
Load Case = [2] = [1] + H2, Pushover Linear

Reference Drift = .02108

Limit state group = all deformation states

Minimum usage ratio for each color : 0.0 0.7 0.8 0.9 1

Negative H1 Life Safety 150% Target Displacement



DEFLECTED SHAPE SHOWING ELEMENT USAGE RATIOS

Structure = EglProject (Pushover of Steel Moment Frame)

Analysis Series = Series 1 (Pushover, -H1)

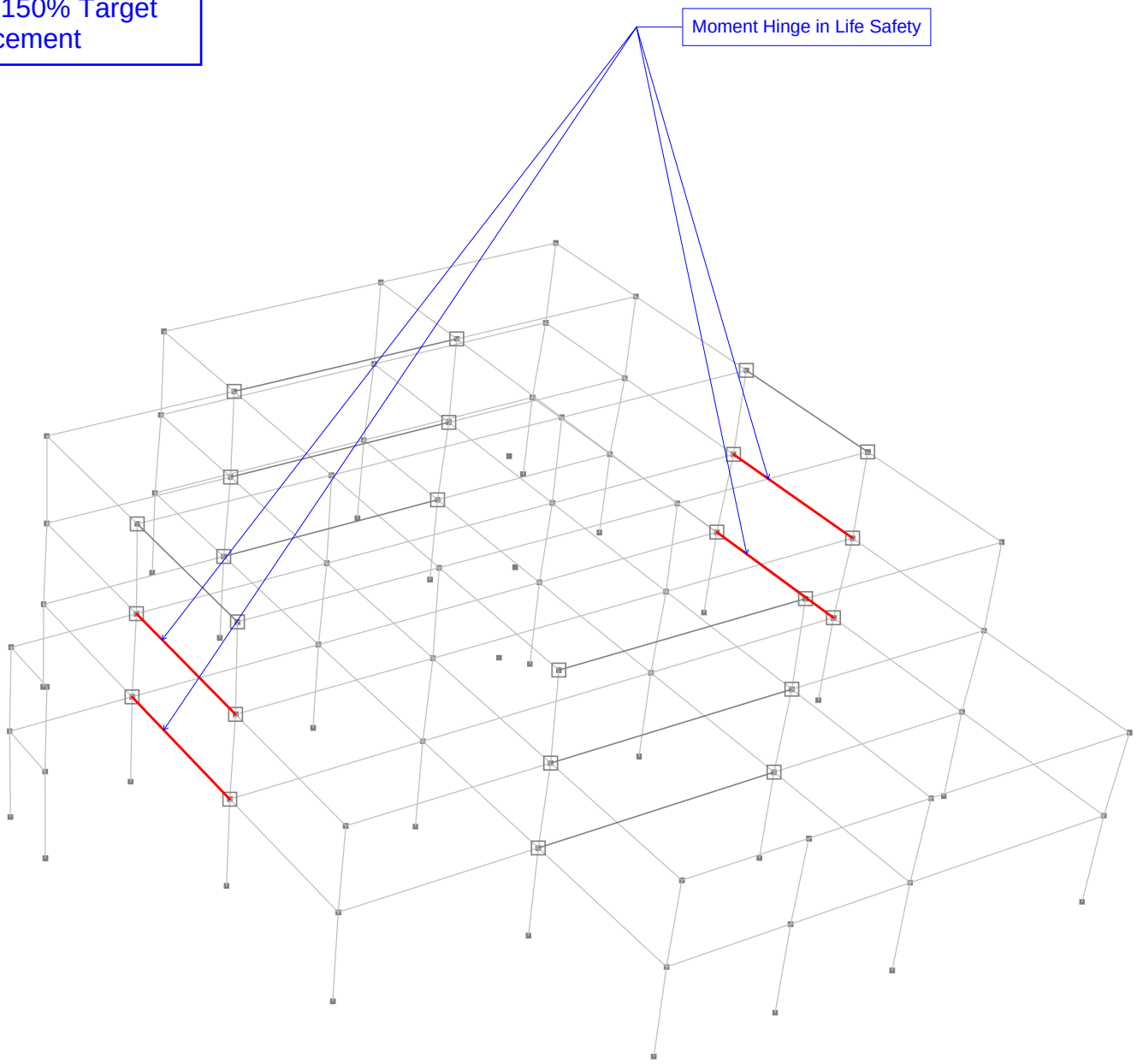
Load Case = [2] = [1] + Pushover, -H1

Reference Drift = .0212

Limit state group = all deformation states

Minimum usage ratio for each color : 0.0 0.7 0.8 0.9 1

Negative H2 Life Safety 150% Target Displacement



DEFLECTED SHAPE SHOWING ELEMENT USAGE RATIOS

Structure = EglProject (Pushover of Steel Moment Frame)

Analysis Series = series 4 (Pushover, -H2)

Load Case = [2] = [1] + Pushover,-H2

Reference Drift = .02123

Limit state group = all deformation states

Minimum usage ratio for each color : 0.0 0.7 0.8 0.9 1

Steel Column Check

Englekirk
www.englekirk.com

Project No 19L-173
Date 02/17/20
Prepared by PP
Sheet No

1717 4th Street :- Column check

FROM RAM SS :- Maximum Load on Roof Column (J-19) :-

$DL = 53.85^{K}$

$LL = 10.25^{K}$

$M_{EQ} = 68.45^{K\text{-}ft}$ (induced due to BSE-2E earthquake spectra)

$\Delta = 2.29''$

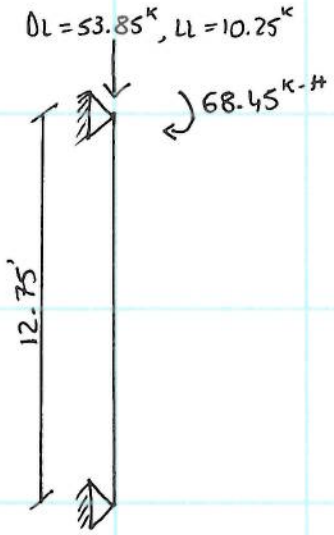
COL SIZE = W12X50

$M_{ux} = 55.17^{K\text{-}ft}$

$M_{uy} = 10.53^{K\text{-}ft}$

$P_u = 57.1^{K}$

$V_u = 4.5^{K}$



$\phi M_{nx} = 194.13^{K\text{-}ft}$
$\phi M_{ny} = 57.51^{K\text{-}ft}$
$\phi P_n = 351.79^{K}$
$\phi V_n = 97.52^{K}$
$\therefore$ OK.

Title Block Line 1
You can change this area
using the "Settings" menu item
and then using the "Printing &
Title Block" selection.
Title Block Line 6

Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 17 FEB 2020, 10:42AM

Steel Column

File = C:\Users\User\Desktop\PP\Projects\17174T-1\Enercalc\P-Delta.ec6

Lic. # : KW-06002321 THE ENGLEKIRK COMPANIES

DESCRIPTION: J-19

Code References

Calculations per AISC 360-10, IBC 2012, CBC 2013, ASCE 7-10
Load Combinations Used : ASCE 7-16

General Information

Steel Section Name :	**W12x50**	Overall Column Height	12.750 ft
Analysis Method :	Load Resistance Factor	Top & Bottom Fixity	Top & Bottom Pinned
Steel Stress Grade		Brace condition for deflection (buckling) along columns :	
Fy : Steel Yield	36.0 ksi	X-X (width) axis :	
E : Elastic Bending Modulus	29,000.0 ksi	Unbraced Length for buckling ABOUT Y-Y Axis = 12.25 ft, K = 1.0	
		Y-Y (depth) axis :	
		Unbraced Length for buckling ABOUT X-X Axis = 12.25 ft, K = 1.0	

Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Column self weight included : 637.50 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 12.750 ft, Xecc = 2.333 in, Yecc = 2.333 in, D = 53.850, LR = 10.250 k
BENDING LOADS . . .
Moment acting about X-X axis at 12.250 ft, E = 68.450 k-ft

DESIGN SUMMARY

Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio = **0.5483** : 1

Load Combination	+D+0.250Lr+E
Location of max.above base	12.237 ft
At maximum location values are . . .	
Pu	57.050 k
0.9 * Pn	351.797 k
Mu-x	55.166 k-ft
0.9 * Mn-x :	194.130 k-ft
Mu-y	-10.527 k-ft
0.9 * Mn-y :	57.510 k-ft

PASS Maximum Shear Stress Ratio = **0.04624** : 1

Load Combination	+D+0.250Lr+E
Location of max.above base	0.0 ft
At maximum location values are . . .	
Vu : Applied	4.508 k
Vn * Phi : Allowable	97.502 k

Maximum Load Reactions . .

Top along X-X	0.9775 k
Bottom along X-X	0.9775 k
Top along Y-Y	5.369 k
Bottom along Y-Y	5.369 k

Maximum Load Deflections . . .

Along Y-Y 0.1090 in at 7.359 ft above base
for load combination : E Only

Along X-X -0.1388 in at 7.445 ft above base
for load combination : +D+Lr

Load Combination Results

Load Combination	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Cbx	Cby	KxLx/Rx	KyLy/Ry	Maximum Shear Ratios: Stress Ratio	Status	Location
+D+0.250Lr+E	0.548	PASS	12.24 ft	1.62	1.66	75.00	28.38	0.046	PASS	0.00 ft

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	Axial Reaction @ Base	X-X Axis Reaction @ Base	@ Top	k	Y-Y Axis Reaction @ Base	@ Top	Mx - End Moments @ Base	k-ft @ Top	My - End Moments @ Base	@ Top
D Only	54.488	0.821	0.821		-0.821	0.821				
+D+Lr	64.738	0.978	0.978		-0.978	0.978				
+D+0.750Lr	62.175	0.938	0.938		-0.938	0.938				
+0.60D	32.693	0.493	0.493		-0.493	0.493				
+D+0.70E	54.488	0.821	0.821		2.937	-2.937				
+D+0.5250E	54.488	0.821	0.821		1.997	-1.997				
+0.60D+0.70E	32.693	0.493	0.493		3.265	-3.265				
Lr Only	10.250	0.156	0.156		-0.156	0.156				
E Only					5.369	-5.369				

Title Block Line 1
You can change this area using the "Settings" menu item and then using the "Printing & Title Block" selection.
Title Block Line 6

Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 17 FEB 2020, 10:42AM

Steel Column

DESCRIPTION: J-19

Extreme Reactions

Item	Extreme Value	Axial Reaction @ Base	X-X Axis Reaction @ Base	X-X Axis Reaction @ Top	k	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Mx - End Moments @ Base	Mx - End Moments @ Top	k-ft	My - End Moments @ Base	My - End Moments @ Top
Axial @ Base	Maximum	64.738	0.978	0.978		-0.978	0.978					
"	Minimum					5.369	-5.369					
Reaction, X-X Axis Base	Maximum	64.738	0.978	0.978		-0.978	0.978					
"	Minimum					5.369	-5.369					
Reaction, Y-Y Axis Base	Maximum					5.369	-5.369					
"	Minimum	64.738	0.978	0.978		-0.978	0.978					
Reaction, X-X Axis Top	Maximum	64.738	0.978	0.978		-0.978	0.978					
"	Minimum					5.369	-5.369					
Reaction, Y-Y Axis Top	Maximum	64.738	0.978	0.978		-0.978	0.978					
"	Minimum	32.693	0.493	0.493		3.265	-3.265					
Moment, X-X Axis Base	Maximum	54.488		0.821		-0.821	0.821					
"	Minimum	54.488		0.821		-0.821	0.821					
Moment, Y-Y Axis Base	Maximum	54.488	0.821	0.821		-0.821	0.821					
"	Minimum	54.488	0.821	0.821		-0.821	0.821					
Moment, X-X Axis Top	Maximum	54.488	0.821	0.821		-0.821	0.821					
"	Minimum	54.488	0.821	0.821		-0.821	0.821					
Moment, Y-Y Axis Top	Maximum	54.488	0.821	0.821		-0.821	0.821					
"	Minimum	54.488	0.821	0.821		-0.821	0.821					

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance		Max. Y-Y Deflection		Distance	
D Only	-0.1166	in	7.445	ft	-0.017	in	7.445	ft
+D+Lr	-0.1388	in	7.445	ft	-0.020	in	7.445	ft
+D+0.750Lr	-0.1332	in	7.445	ft	-0.019	in	7.445	ft
+0.60D	-0.0699	in	7.445	ft	-0.010	in	7.445	ft
+D+0.70E	-0.1166	in	7.445	ft	0.059	in	7.359	ft
+D+0.5250E	-0.1166	in	7.445	ft	0.040	in	7.359	ft
+0.60D+0.70E	-0.0699	in	7.445	ft	0.066	in	7.359	ft
Lr Only	-0.0222	in	7.445	ft	-0.003	in	7.445	ft
E Only	0.0000	in	0.000	ft	0.109	in	7.359	ft

Steel Section Properties : W12x50

Depth	=	12.200 in	Ixx	=	391.00 in^4	J	=	1.710 in^4
Web Thick	=	0.370 in	S xx	=	64.20 in^3	Cw	=	1,880.00 in^6
Flange Width	=	8.080 in	R xx	=	5.180 in			
Flange Thick	=	0.640 in	Zx	=	71.900 in^3			
Area	=	14.600 in^2	I yy	=	56.300 in^4			
Weight	=	50.000 plf	S yy	=	13.900 in^3	Wno	=	23.400 in^2
Kdesign	=	1.140 in	R yy	=	1.960 in	Sw	=	30.200 in^4
K1	=	0.938 in	Zy	=	21.300 in^3	Qf	=	14.300 in^3
rts	=	2.250 in				Qw	=	35.400 in^3
Ycg	=	0.000 in						

Title Block Line 1
You can change this area
using the "Settings" menu item
and then using the "Printing &
Title Block" selection.
Title Block Line 6

Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 17 FEB 2020, 10:42AM

Steel Column

File = C:\Users\User\Desktop\PP\Projects\17174T~1\Enercalc\P-Della.ec6

Lic. # : KW-06002321

THE ENGLEKIRK COMPANIES

DESCRIPTION: J-19

Sketches