

**RDA SHEAR FORCES TO STEEL LFERS ELEMENTS - LEVEL 2**  
**ASCE 7 SECTION 12.8 - EQUIVALENT LATERAL FORCE PROCEDURE - RIGID DIAPHRAGM ANALYSIS**  
**SAMPLE PROJECT, ANYTOWN - NEW DESIGN**

Floor Level : **2**

**1. General Design Parameters**

H<sub>A</sub> = 12.00 feet (Height of Floor Level Above)  
 H<sub>B</sub> = 15.00 feet (Height of Floor Level Below)

**Story Shear - N-S Direction (Y)**

LFERS System: SMRF V<sub>S</sub> = 907 kips (Story Shear)  
 C<sub>S</sub> = 0.071 g's (Seismic Coefficient)

**Story Shear - W-E Direction (X)**

LFERS System: SMRF V<sub>S</sub> = 907 kips (Story Shear)  
 C<sub>S</sub> = 0.071 g's (Seismic Coefficient)

RC Diaphragm Dimensions						
Section	Length (feet)	Width (feet)	Thick-ness (inches)	x (feet)	y (feet)	Weight (kips)
1	92.00	152.00	9.00	-	-	1,521
2	0.00	0.00	0.00	0.00	0.00	0
3	0.00	0.00	0.00	0.00	0.00	0

**Moment Frame Beams - N-S Direction (Y)**

WF Shape = **W30X116**

**Moment Frame Beams - W-E Direction (X)**

WF Shape = **W30X108**

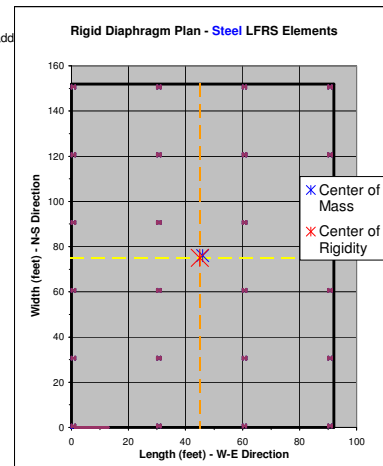
**Accidental Eccentricity (ASCE Section 12.8.4.2):**

e<sub>MIN</sub> = 5.0 % (accidental eccentricity)

=> e<sub>AX</sub> A<sub>XY</sub> = 7.60 feet for A<sub>XY</sub> = 1.00 (N-S Amplification of Accidental Torsional Moment - from RDA Displacements)  
 e<sub>AY</sub> A<sub>XX</sub> = 4.60 feet for A<sub>XX</sub> = 1.00 (W-E Amplification of Accidental Torsional Moment - from RDA Displacements)

Material Data: E<sub>S</sub> = 29,000 ksi

for ρ = 145 pcf (Unit Weight)  
 W<sub>w</sub> = 30.0 psf (Weight of Exterior Walls or Cladd)



**2. Stiffness Parameters**

**Center of Mass (CM):**

x<sub>CM</sub> = 46.00 feet  
 y<sub>CM</sub> = 76.00 feet

**Center of Rigidity (CR):**

x<sub>CR</sub> = 45.00 feet  
 y<sub>CR</sub> = 75.00 feet

Note: Center of Mass calculations neglect weight of walls parallel to loading direction.

**Eccentricities:**

	CR - CM	e <sub>ACC</sub> = e <sub>A</sub> A <sub>X</sub>	Sum Value	
e <sub>x</sub>	-1.00	7.60	-8.60	feet
e <sub>y</sub>	-1.00	4.60	-5.60	feet

Polar Moment of Inertia: J<sub>o</sub> = Σ r<sub>i</sub><sup>2</sup> K<sub>i</sub> Where r<sub>i</sub> = As shown in Table below  
 K<sub>i</sub> = As shown in Table below

J<sub>o</sub> = 118,166 ft<sup>2</sup>

**3. Building Lateral and Torsional Loading:**

V<sub>C</sub> = F<sub>C</sub> = F<sub>Shear</sub> + F<sub>Torsion</sub> = (F K<sub>i</sub>) / Σ K<sub>i</sub> +/- (T r<sub>i</sub> K<sub>i</sub>) / J<sub>o</sub>

**a) North-South Loading**

F<sub>NS</sub> = C<sub>S</sub> W<sub>NS</sub> or V<sub>S</sub> Where C<sub>S</sub> = 0.071 g's (Seismic Coefficient)  
 W<sub>NS</sub> = kips (Floor + WE Ext Walls)  
 V<sub>S</sub> = 907 kips (Story Shear)

F<sub>NS</sub> = 907 kips (Story Shear - N-S)

T<sub>NS</sub> = F<sub>NS</sub> e<sub>x</sub> Where e<sub>x</sub> = -8.60 feet for Loading Direction = +/-

T<sub>NS</sub> = -7,801 kip-ft (Torsional Loading - N-S)

**b) West-East Loading**

F<sub>WE</sub> = C<sub>S</sub> W<sub>WE</sub> or V<sub>S</sub> Where C<sub>S</sub> = 0.071 g's (Seismic Coefficient)  
 W<sub>WE</sub> = kips (Floor + Ext NS Walls)  
 V<sub>S</sub> = 907 kips (Story Shear)

F<sub>WE</sub> = 907 kips (Story Shear - W-E)

T<sub>WE</sub> = F<sub>WE</sub> e<sub>y</sub> Where e<sub>y</sub> = -5.60 feet for Loading Direction = +/-

T<sub>WE</sub> = -5,080 kip-ft (Torsional Loading - W-E)

**4. RDA Load Distribution to Steel LFERS Elements (Braced Frame or SMRF)**

Building Direction	Steel Element ID	H (feet)	LFERS Option Data					SMRF Option Data					Coordinates <sup>1</sup>				LFERS STIFFNESS		Loads to Steel LFERS Elements								
			Braced Frame	L (feet)	t (inches)	K (kip/in)	Column Type (I or E)	AISC Shape	Strong/Weak Axis	I <sub>x</sub> / I <sub>y</sub> (in <sup>4</sup> )	d (inches)	b <sub>f</sub> (inches)	Fixity at Column	x (feet)	y (feet)	x <sub>wall</sub> (ft)	y <sub>wall</sub> (ft)	r <sub>i</sub> (ft)	K (kip/in)	K <sub>REL</sub>	N-S Loading			W-E Loading			V <sub>C</sub> (kips)
																					F <sub>Shear</sub> (kips)	F <sub>Torsion</sub> (kips)	F <sub>D</sub> (kips)	F <sub>Shear</sub> (kips)	F <sub>Torsion</sub> (kips)	F <sub>D</sub> (kips)	
N-S	1	15.00					E	W14X233	W	1,150	16.00	15.90		0.00	0.00	0.66	0.67	-44.34	60	1.00	29	2.9	32	-	1.9	2	31.7
	2	15.00					E	W14X233	W	1,150	16.00	15.90		30.00	0.00	30.66	0.67	-14.34	60	1.00	29	0.9	30	-	0.6	1	29.7
	3	15.00					E	W14X233	W	1,150	16.00	15.90		60.00	0.00	60.66	0.67	15.66	60	1.00	29	-1.0	28	-	-0.7	-1	27.7
	4	15.00					E	W14X233	W	1,150	16.00	15.90		90.00	0.00	90.66	0.67	45.66	60	1.00	29	-3.0	26	-	-2.0	-2	25.7
	5	15.00					E	W14X233	W	1,150	16.00	15.90		0.00	30.00	0.66	30.67	-44.34	86	1.43	41	4.2	45	-	2.7	3	45.2
	6	15.00					I	W14X257	W	1,290	16.40	16.00		30.00	30.00	30.67	30.68	-14.33	92	1.52	44	1.4	45	-	0.9	1	45.1
	7	15.00					I	W14X257	W	1,290	16.40	16.00		60.00	30.00	60.67	30.68	15.67	92	1.52	44	-1.6	42	-	-1.0	-1	42.1
	8	15.00					E	W14X233	W	1,150	16.00	15.90		90.00	30.00	90.66	30.67	45.66	86	1.43	41	-4.3	37	-	-2.8	-3	36.7
	9	15.00					E	W14X233	W	1,150	16.00	15.90		0.00	60.00	0.66	60.67	-44.34	86	1.43	41	4.2	45	-	2.7	3	45.2
	10	15.00					I	W14X257	W	1,290	16.40	16.00		30.00	60.00	30.67	60.68	-14.33	92	1.52	44	1.4	45	-	0.9	1	45.1
	11	15.00					I	W14X257	W	1,290	16.40	16.00		60.00	60.00	60.67	60.68	15.67	92	1.52	44	-1.6	42	-	-1.0	-1	42.1
	12	15.00					E	W14X233	W	1,150	16.00	15.90		90.00	60.00	90.66	60.67	45.66	86	1.43	41	-4.3	37	-	-2.8	-3	36.7
	13	15.00					E	W14X233	W	1,150	16.00	15.90		0.00	90.00	0.66	90.67	-44.34	86	1.43	41	4.2	45	-	2.7	3	45.2
	14	15.00					I	W14X257	W	1,290	16.40	16.00		30.00	90.00	30.67	90.68	-14.33	92	1.52	44	1.4	45	-	0.9	1	45.1
	15	15.00					I	W14X257	W	1,290	16.40	16.00		60.00	90.00	60.67	90.68	15.67	92	1.52	44	-1.6	42	-	-1.0	-1	42.1
	16	15.00					E	W14X233	W	1,150	16.00	15.90		90.00	90.00	90.66	90.67	45.66	86	1.43	41	-4.3	37	-	-2.8	-3	36.7
	17	15.00					E	W14X233	W	1,150	16.00	15.90		0.00	120.00	0.66	120.67	-44.34	86	1.43	41	4.2	45	-	2.7	3	45.2
	18	15.00					I	W14X257	W	1,290	16.40	16.00		30.00	120.00	30.67	120.68	-14.33	92	1.52	44	1.4	45	-	0.9	1	45.1
	19	15.00					I	W14X257	W	1,290	16.40	16.00		60.00	120.00	60.67	120.68	15.67	92	1.52	44	-1.6	42	-	-1.0	-1	42.1
	20	15.00					E	W14X233	W	1,150	16.00	15.90		90.00	120.00	90.66	120.67	45.66	86	1.43	41	-4.3	37	-	-2.8	-3	36.7
	21	15.00					E	W14X233	W	1,150	16.00	15.90		0.00	150.00	0.66	150.67	-44.34	60	1.00	29	2.9	32	-	1.9	2	31.7
	22	15.00					E	W14X233	W	1,150	16.00	15.90		30.00	150.00	30.66	150.67	-14.34	60	1.00	29	0.9	30	-	0.6	1	29.7
	23	15.00					E	W14X233	W	1,150	16.00	15.90		60.00	150.00	60.66	150.67	15.66	60	1.00	29	-1.0	28	-	-0.7	-1	27.7
	24	15.00					E	W14X233	W	1,150	16.00	15.90		90.00	150.00	90.66	150.67	45.66	60	1.00	29	-3.0	26	-	-2.0	-2	25.7
	25																										
	26																										
	27																										
	28																										
	29																										
	30																										
	31																										
	32																										

Building Direction	Steel Element ID	H (feet)	LFERS Option Data					SMRF Option Data					Coordinates <sup>1</sup>				LFERS STIFFNESS		Loads to Steel LFERS Elements								
			Braced Frame	L (feet)	t (inches)	K (kip/in)	Column Type (I or E)	AISC Shape	Strong/Weak Axis	I <sub>x</sub> / I <sub>y</sub> (in <sup>4</sup> )	d (inches)	b <sub>f</sub> (inches)	Fixity at Column	x (feet)	y (feet)	x <sub>wall</sub> (ft)	y <sub>wall</sub> (ft)	r <sub>i</sub> (ft)	K (kip/in)	K <sub>REL</sub>	N-S Loading			W-E Loading			V <sub>C</sub> (kips)
																					F <sub>Shear</sub> (kips)	F <sub>Torsion</sub> (kips)	F <sub>D</sub> (kips)	F <sub>Shear</sub> (kips)	F <sub>Torsion</sub> (kips)	F <sub>D</sub> (kips)	
N-S	1	15.00					E	W14X233	W	1,150	16.00	15.90		0.00	0.00	0.66	0.67	-44.34	60	1.00	29	2.9	32	-	1.9	2	31.7
	2	15.00					E	W14X233	W	1,150	16.00	15.90		30.00	0.00	30.66	0.67	-14.34	60	1.00	29	0.9	30	-	0.6	1	29.7
	3	15.00					E	W14X233	W	1,150	16.00	15.90		60.00	0.00	60.66	0.67	15.66	60	1.00	29	-1.0	28	-	-0.7	-1	27.7
	4	15.00					E	W14X233	W	1,150	16.00	15.90		90.00	0.00	90.66	0.67	45.66	60	1.00	29	-3.0	26	-	-2.0	-2	25.7
	5	15.00					E	W14X233	W	1,150	16.00	15.90		0.00	30.00	0.66	30.67	-44.34	86	1.43	41	4.2	45	-	2.7	3	45.2
	6	15.00					I	W14X257	W	1,290	16.40	16.00		30.00	30.00	30.67	30.68	-14.33	92	1.52	44	1.4	45	-	0.9	1	45.1
	7	15.00					I	W14X257	W	1,290</																	

**RDA SHEAR FORCES TO STEEL LFERS ELEMENTS - LEVEL 2**  
**ASCE 7 SECTION 12.8 - EQUIVALENT LATERAL FORCE PROCEDURE - RIGID DIAPHRAGM ANALYSIS**  
**SAMPLE PROJECT, ANYTOWN - NEW DESIGN**

Floor Level : 2

**1. General Design Parameters**

H<sub>A</sub> = 12.00 feet (Height of Floor Level Above)  
 H<sub>B</sub> = 15.00 feet (Height of Floor Level Below)

**Story Shear - N-S Direction (Y)**

LFERS System: SMRF V<sub>S</sub> = 907 kips (Story Shear)  
 C<sub>S</sub> = 0.071 g's (Seismic Coefficient)

**Story Shear - W-E Direction (X)**

LFERS System: SMRF V<sub>S</sub> = 907 kips (Story Shear)  
 C<sub>S</sub> = 0.071 g's (Seismic Coefficient)

RC Diaphragm Dimensions						
Section	Length (feet)	Width (feet)	Thick-ness (inches)	x (feet)	y (feet)	Weight (kips)
1	92.00	152.00	9.00	-	-	1,521
2	0.00	0.00	0.00	0.00	0.00	0
3	0.00	0.00	0.00	0.00	0.00	0

**Moment Frame Beams - N-S Direction (Y)**

WF Shape = W30X116

**Moment Frame Beams - W-E Direction (X)**

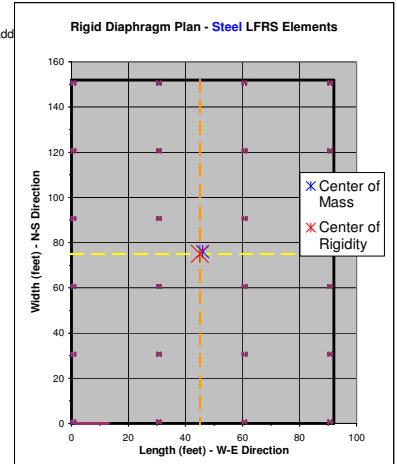
WF Shape = W30X108

**Accidental Eccentricity (ASCE (Section 12.8.4.2):**

e<sub>MIN</sub> = 5.0 % (accidental eccentricity)  
 => e<sub>AX</sub> A<sub>XY</sub> = 7.60 feet for A<sub>XY</sub> = 1.00 (N-S Amplification of Accidental Torsional Moment - from RDA Displacements)  
 e<sub>AY</sub> A<sub>XX</sub> = 4.60 feet for A<sub>XX</sub> = 1.00 (W-E Amplification of Accidental Torsional Moment - from RDA Displacements)

Material Data: E<sub>S</sub> = 29,000 ksi

for ρ = 145 pcf (Unit Weight)  
 W<sub>w</sub> = 30.0 psf (Weight of Exterior Walls or Cladd)



**2. Stiffness Parameters**

Center of Mass (CM): x<sub>CM</sub> = 46.00 feet, y<sub>CM</sub> = 76.00 feet  
 Center of Rigidity (CR): x<sub>CR</sub> = 45.00 feet, y<sub>CR</sub> = 75.00 feet

Note: Center of Mass calculations neglect weight of walls parallel to loading direction.

Eccentricities:	CR - CM	e <sub>ACC</sub> = e <sub>A</sub> A <sub>X</sub>	Sum Value
e <sub>x</sub>	-1.00	7.60	-8.60 feet
e <sub>y</sub>	-1.00	4.60	-5.60 feet

Polar Moment of Inertia: J<sub>o</sub> = ∑ r<sub>i</sub><sup>2</sup> K<sub>i</sub> Where r<sub>i</sub> = As shown in Table below  
 K<sub>i</sub> = As shown in Table below

J<sub>o</sub> = 118,166 ft<sup>2</sup>

**3. Building Lateral and Torsional Loading:**

V<sub>C</sub> = F<sub>C</sub> = F<sub>Shear</sub> + F<sub>Torsion</sub> = (F K<sub>i</sub>) / ∑ K<sub>i</sub> +/- (T r<sub>i</sub> K<sub>i</sub>) / J<sub>o</sub>

**a) North-South Loading**

F<sub>NS</sub> = C<sub>S</sub> W<sub>NS</sub> or V<sub>S</sub> Where C<sub>S</sub> = 0.071 g's (Seismic Coefficient)  
 W<sub>NS</sub> = kips (Floor + WE Ext Walls)  
 V<sub>S</sub> = 907 kips (Story Shear)

F<sub>NS</sub> = 907 kips (Story Shear - N-S)

T<sub>NS</sub> = F<sub>NS</sub> e<sub>x</sub> Where e<sub>x</sub> = -8.60 feet for Loading Direction = +/-

T<sub>NS</sub> = -7,801 kip-ft (Torsional Loading - N-S)

**b) West-East Loading**

F<sub>WE</sub> = C<sub>S</sub> W<sub>WE</sub> or V<sub>S</sub> Where C<sub>S</sub> = 0.071 g's (Seismic Coefficient)  
 W<sub>WE</sub> = kips (Floor + Ext NS Walls)  
 V<sub>S</sub> = 907 kips (Story Shear)

F<sub>WE</sub> = 907 kips (Story Shear - W-E)

T<sub>WE</sub> = F<sub>WE</sub> e<sub>y</sub> Where e<sub>y</sub> = -5.60 feet for Loading Direction = +/-

T<sub>WE</sub> = -5,080 kip-ft (Torsional Loading - W-E)

**4. RDA Load Distribution to Steel LFERS Elements (Braced Frame or SMRF)**

Building Direction	Steel Element ID	LFERS Option Data						SMRF Option Data						Coordinates <sup>1</sup>			LFERS STIFFNESS		Loads to Steel LFERS Elements								
		H (feet)	Braced Frame	L (feet)	t (inches)	K (kip/in)	Column Type (I or E)	AISC Shape	Strong / Weak Axis	I <sub>x</sub> / I <sub>y</sub> (in <sup>4</sup> )	d (inches)	b <sub>f</sub> (inches)	Fixity at Column	x (feet)	y (feet)	x <sub>wall</sub> (ft)	y <sub>wall</sub> (ft)	r <sub>i</sub> (ft)	K (kip/in)	K <sub>REL</sub>	N-S Loading		W-E Loading				V <sub>C</sub> (kips)
																					F <sub>Shear</sub> (kips)	F <sub>Torsion</sub> (kips)	F <sub>D</sub> (kips)	F <sub>Shear</sub> (kips)	F <sub>Torsion</sub> (kips)	F <sub>D</sub> (kips)	
W-E	1	15.00					E	W14X233	S	3,010	16.00	15.90		0.00	0.00	0.67	0.66	-74.34	63	1.04	-	5.1	5	29	3.3	33	32.6
	2	15.00					E	W14X233	S	3,010	16.00	15.90		30.00	0.00	30.67	0.66	-74.34	95	1.58	-	7.7	8	45	5.0	50	49.6
	3	15.00					E	W14X233	S	3,010	16.00	15.90		60.00	0.00	60.67	0.66	-74.34	95	1.58	-	7.7	8	45	5.0	50	49.6
	4	15.00					E	W14X233	S	3,010	16.00	15.90		90.00	0.00	90.67	0.66	-74.34	63	1.04	-	5.1	5	29	3.3	33	32.6
	5	15.00					E	W14X233	S	3,010	16.00	15.90		0.00	30.00	0.67	30.66	-44.34	63	1.04	-	3.0	3	29	2.0	31	31.3
	6	15.00					I	W14X257	S	3,400	16.40	16.00		30.00	30.00	30.68	30.67	-44.33	101	1.67	-	4.9	5	47	3.2	50	50.4
	7	15.00					I	W14X257	S	3,400	16.40	16.00		60.00	30.00	60.68	30.67	-44.33	101	1.67	-	4.9	5	47	3.2	50	50.4
	8	15.00					E	W14X233	S	3,010	16.00	15.90		90.00	30.00	90.67	30.66	-44.34	63	1.04	-	3.0	3	29	2.0	31	31.3
	9	15.00					E	W14X233	S	3,010	16.00	15.90		0.00	60.00	0.67	60.66	-14.34	63	1.04	-	1.0	1	29	0.6	30	29.9
	10	15.00					I	W14X257	S	3,400	16.40	16.00		30.00	60.00	30.68	60.67	-14.33	101	1.67	-	1.6	2	47	1.0	48	48.2
	11	15.00					I	W14X257	S	3,400	16.40	16.00		60.00	60.00	60.68	60.67	-14.33	101	1.67	-	1.6	2	47	1.0	48	48.2
	12	15.00					E	W14X233	S	3,010	16.00	15.90		90.00	60.00	90.67	60.66	-14.34	63	1.04	-	1.0	1	29	0.6	30	29.9
	13	15.00					E	W14X233	S	3,010	16.00	15.90		0.00	90.00	0.67	90.66	15.66	63	1.04	-	-1.1	-1	29	-0.7	29	28.6
	14	15.00					I	W14X257	S	3,400	16.40	16.00		30.00	90.00	30.68	90.67	15.67	101	1.67	-	-1.7	-2	47	-1.1	46	46.1
	15	15.00					I	W14X257	S	3,400	16.40	16.00		60.00	90.00	60.68	90.67	15.67	101	1.67	-	-1.7	-2	47	-1.1	46	46.1
	16	15.00					E	W14X233	S	3,010	16.00	15.90		90.00	90.00	90.67	90.66	15.66	63	1.04	-	-1.1	-1	29	-0.7	29	28.6
	17	15.00					E	W14X233	S	3,010	16.00	15.90		0.00	120.00	0.67	120.66	45.66	63	1.04	-	-3.1	-3	29	-2.0	27	27.3
	18	15.00					I	W14X257	S	3,400	16.40	16.00		30.00	120.00	30.68	120.67	45.67	101	1.67	-	-5.0	-5	47	-3.3	44	43.9
	19	15.00					I	W14X257	S	3,400	16.40	16.00		60.00	120.00	60.68	120.67	45.67	101	1.67	-	-5.0	-5	47	-3.3	44	43.9
	20	15.00					E	W14X233	S	3,010	16.00	15.90		90.00	120.00	90.67	120.66	45.66	63	1.04	-	-3.1	-3	29	-2.0	27	27.3
	21	15.00					E	W14X233	S	3,010	16.00	15.90		0.00	150.00	0.67	150.66	75.66	63	1.04	-	-5.2	-5	29	-3.4	26	25.9
	22	15.00					E	W14X233	S	3,010	16.00	15.90		30.00	150.00	30.67	150.66	75.66	95	1.58	-	-7.9	-8	45	-5.1	39	39.4
	23	15.00					E	W14X233	S	3,010	16.00	15.90		60.00	150.00	60.67	150.66	75.66	95	1.58	-	-7.9	-8	45	-5.1	39	39.4
	24	15.00					E	W14X233	S	3,010	16.00	15.90		90.00	150.00	90.67	150.66	75.66	63	1.04	-	-5.2	-5	29	-3.4	26	25.9
	25																										
	26																										
	27																										
	28																										
	29																										
	30																										
	31																										
	32																										