

Project Sample Project, Anytown  
 Job No. 202322.1  
 By AL  
 Date 11/27/23  
 Sheet \_\_\_\_ of \_\_\_\_

**Company Name**  
 Company Address  
 Company Tel/Fax  
 Company Website

NBSD-Software.com

**AXIAL OVERTURNING FORCES TO STEEL 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**

Overtuning Moments about Roof:

M<sub>ONS</sub> = 66,830 Kip-ft (N-S direction)

M<sub>OWE</sub> = 66,830 Kip-ft (W-E direction)

Overtuning Moments - Options:

OT Loads resisted in both LFRS directions:  (Y or N)

Columns resist Forces in both LFRS directions:  (Y for Space or 3D LFR Frames,

RC Diaphragm Dimensions					
Section	Length (feet)	Width (feet)	Thickness (inches)	x (feet)	y (feet)
1	92.00	152.00	9.00	-	-
2	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00

Center of Mass:

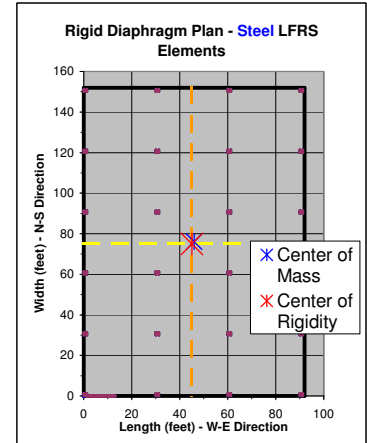
x<sub>CM</sub> = 46.00 feet

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

Center of Rigidity:

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

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



**2. Determination of Axial Loads - Overtuning**

Note: Axial loads are assumed distributed to Perimeter Edge Columns only in the direction of loading, as follows:

$$P_{WE} = \frac{M_{OWE} D_x}{\sum D_x^2}$$

Where M<sub>OWE</sub> = 66,830 Kip-ft

D<sub>x</sub> = Element distance to Longitudinal Center of Rotation

$$P_{NS} = \frac{M_{ONS} D_y}{\sum D_y^2}$$

Where M<sub>ONS</sub> = 66,830 Kip-ft

D<sub>y</sub> = Element distance to Vertical Center of Rotation

Threshold Limit = 30.00 feet (Max distance from Perimeter Column to Edge of Slab)

**3. Distance to Center of Rotation for LFRS Elements and Resulting RDA Axial Loads**

LFRS Direction	Steel Element ID	H (feet)	LFRS Option Data						Coordinates <sup>1</sup>		Centroids		Distance to CR		D <sub>x</sub> <sup>2</sup>	D <sub>y</sub> <sup>2</sup>	Axial Forces from Overtuning					
			Braced Frame	L (feet)	t (inches)	Column Type (I or E)	AISC Shape	Strong / Weak Axis	x (feet)	y (feet)	x <sub>i</sub> (ft)	y <sub>i</sub> (ft)	D <sub>x</sub> (ft)	D <sub>y</sub> (ft)			P <sub>WE</sub> (Kips)	P <sub>NS</sub> (Kips)	P <sub>OT</sub> (Kips)			
N-S	1	15.00				E	W14X233	W	0.00	0.00	0.66	0.67			74.33		5,525		110	110		
	2	15.00				E	W14X233	W	30.00	0.00	30.66	0.67			74.33		5,525		110	110		
	3	15.00				E	W14X233	W	60.00	0.00	60.66	0.67			74.33		5,525		110	110		
	4	15.00				E	W14X233	W	90.00	0.00	90.66	0.67			74.33		5,525		110	110		
	5	15.00				E	W14X233	W	0.00	30.00	0.66	30.67										
	6	15.00				I	W14X257	W	30.00	30.00	30.67	30.68										
	7	15.00				I	W14X257	W	60.00	30.00	60.67	30.68										
	8	15.00				E	W14X233	W	90.00	30.00	90.66	30.67										
	9	15.00				E	W14X233	W	0.00	60.00	0.66	60.67										
	10	15.00				I	W14X257	W	30.00	60.00	30.67	60.68										
	11	15.00				I	W14X257	W	60.00	60.00	60.67	60.68										
	12	15.00				E	W14X233	W	90.00	60.00	90.66	60.67										
	13	15.00				E	W14X233	W	0.00	90.00	0.66	90.67										
	14	15.00				I	W14X257	W	30.00	90.00	30.67	90.68										
	15	15.00				I	W14X257	W	60.00	90.00	60.67	90.68										
	16	15.00				E	W14X233	W	90.00	90.00	90.66	90.67										
	17	15.00				E	W14X233	W	0.00	120.00	0.66	120.67										
	18	15.00				I	W14X257	W	30.00	120.00	30.67	120.68										
	19	15.00				I	W14X257	W	60.00	120.00	60.67	120.68										
	20	15.00				E	W14X233	W	90.00	120.00	90.66	120.67										
	21	15.00				E	W14X233	W	0.00	150.00	0.66	150.67			-75.67		5,725					
	22	15.00				E	W14X233	W	30.00	150.00	30.66	150.67			-75.67		5,725					
	23	15.00				E	W14X233	W	60.00	150.00	60.66	150.67			-75.67		5,725					
	24	15.00				E	W14X233	W	90.00	150.00	90.66	150.67			-75.67		5,725					
	25																					
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 Columns resist Forces in both LFRS directions:  (Y for Space or 3D LFR Frames,

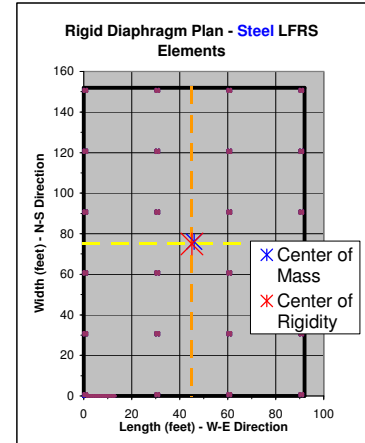
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Section	Length (feet)	Width (feet)	Thickness (inches)	x (feet)	y (feet)
1	92.00	152.00	9.00	-	-
2	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00

Center of Mass:

$x_{CM} = 46.00$  feet  
 $y_{CM} = 76.00$  feet

Center of Rigidity:

$x_{CR} = 45.00$  feet  
 $y_{CR} = 75.00$  feet



Threshold Limit = 30.00 feet (Max distance from Perimeter Column to Edge of Slab)

**2. Determination of Axial Loads - Overtuning**

Note: Axial loads are assumed distributed to Perimeter Edge Columns only in the direction of loading, as follows:

$P_{WE} = \frac{M_{WE} D_x}{\sum D_x^2}$  Where  $M_{WE} = 66,830$  Kip-ft  
 $D_x =$  Element distance to Longitudinal Center of Rotation

$P_{NS} = \frac{M_{ONS} D_y}{\sum D_y^2}$  Where  $M_{ONS} = 66,830$  Kip-ft  
 $D_y =$  Element distance to Vertical Center of Rotation

**3. Distance to Center of Rotation for LFRS Elements and Resulting RDA Axial Loads**

LFRS Direction	Steel Element ID	H (feet)	Braced Frame	L (feet)	t (inches)	LFRS Option Data				Coordinates <sup>1</sup>		Centroids		Distance to CR		Axial Forces from Overtuning			
						Column Type (I or E)	AISC Shape	Strong / Weak Axis	x (feet)	y (feet)	$x_i$ (ft)	$y_i$ (ft)	$D_x$ (ft)	$D_y$ (ft)	$D_x^2$	$D_y^2$	$P_{WE}$ (Kips)	$P_{NS}$ (Kips)	$P_{OT}$ (Kips)
W-E	1	15.00				E	W14X233	S	0.00	0.00	0.67	0.66	44.33		1,965		122		122
	2	15.00				E	W14X233	S	30.00	0.00	30.67	0.66							
	3	15.00				E	W14X233	S	60.00	0.00	60.67	0.66							
	4	15.00				E	W14X233	S	90.00	0.00	90.67	0.66	-45.67		2,085		-126		-126
	5	15.00				E	W14X233	S	0.00	30.00	0.67	30.66	44.33		1,965		122		122
	6	15.00				I	W14X257	S	30.00	30.00	30.68	30.67							
	7	15.00				I	W14X257	S	60.00	30.00	60.68	30.67							
	8	15.00				E	W14X233	S	90.00	30.00	90.67	30.66	-45.67		2,085		-126		-126
	9	15.00				E	W14X233	S	0.00	60.00	0.67	60.66	44.33		1,965		122		122
	10	15.00				I	W14X257	S	30.00	60.00	30.68	60.67							
	11	15.00				I	W14X257	S	60.00	60.00	60.68	60.67							
	12	15.00				E	W14X233	S	90.00	60.00	90.67	60.66	-45.67		2,085		-126		-126
	13	15.00				E	W14X233	S	0.00	90.00	0.67	90.66	44.33		1,965		122		122
	14	15.00				I	W14X257	S	30.00	90.00	30.68	90.67							
	15	15.00				I	W14X257	S	60.00	90.00	60.68	90.67							
	16	15.00				E	W14X233	S	90.00	90.00	90.67	90.66	-45.67		2,085		-126		-126
	17	15.00				E	W14X233	S	0.00	120.00	0.67	120.66	44.33		1,965		122		122
	18	15.00				I	W14X257	S	30.00	120.00	30.68	120.67							
	19	15.00				I	W14X257	S	60.00	120.00	60.68	120.67							
	20	15.00				E	W14X233	S	90.00	120.00	90.67	120.66	-45.67		2,085		-126		-126
	21	15.00				E	W14X233	S	0.00	150.00	0.67	150.66	44.33		1,965		122		122
	22	15.00				E	W14X233	S	30.00	150.00	30.67	150.66							
	23	15.00				E	W14X233	S	60.00	150.00	60.67	150.66							
	24	15.00				E	W14X233	S	90.00	150.00	90.67	150.66	-45.67		2,085		-126		-126
	25																		
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