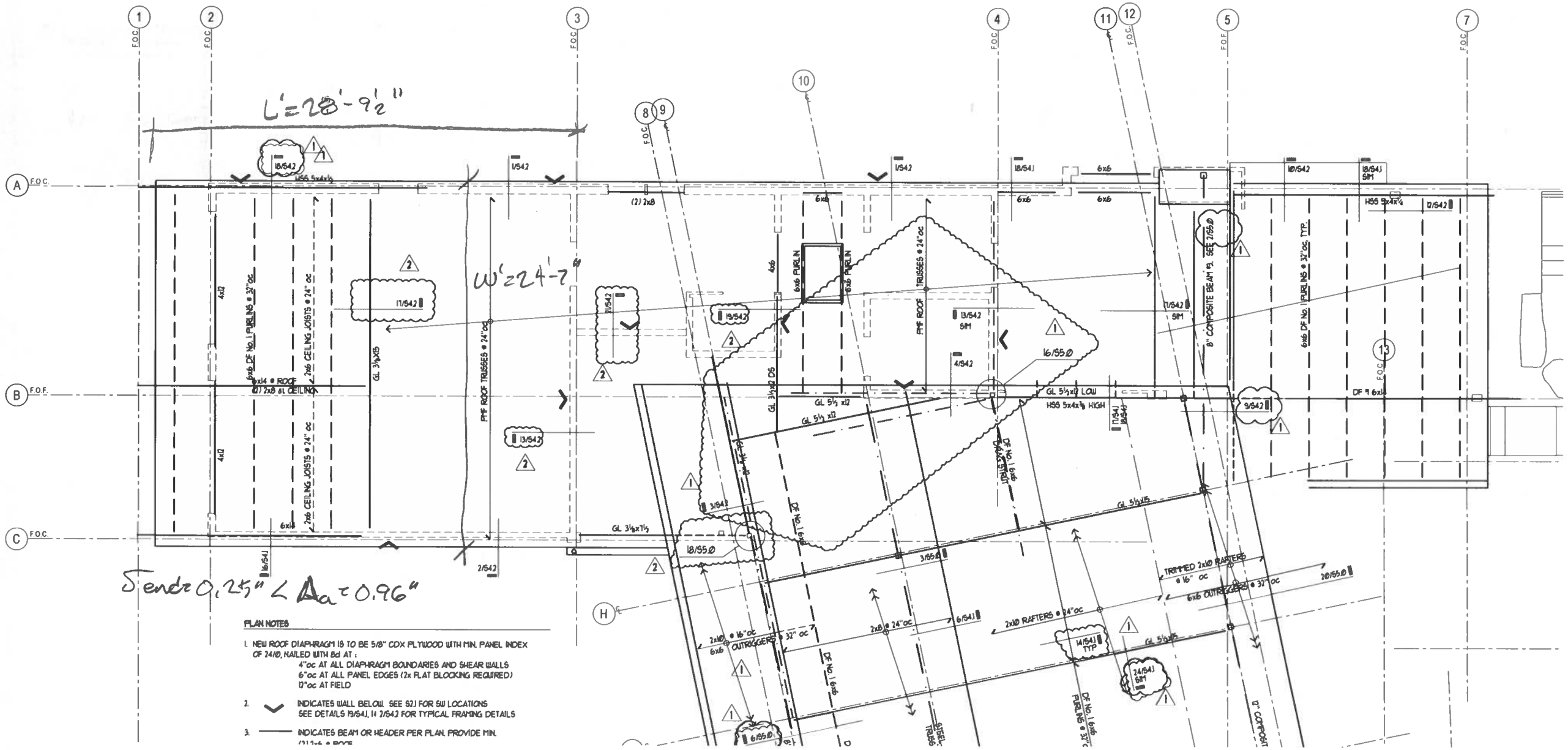
OPEN FRONT DIAPHRAGM REQUIREMENTS PER 2015 NDS SDPWS 4.2.5.2

1) DIAPHRAGM CONFORMS TO 4.2.7.1.1 - 5/8" CDX DIAPHRAGM w/ BLOCKED EDGES & 4"/12" NAILSPACING COMPLIES

2) L'/W' RATIO IS ≤ 1.5:1 , L'=29', W'=24' ∴ L':W' = 1.17 < 1.5 ✓OK

3) Evaluate Diaphragm w/ Idealized Rigid load distribution
   - Rigid Analysis and load distribution completed 4/2021

4) Maximum L'=35' - Actual L'=29' < 35' ✓OK



Mark Speidel, PE, SE
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23914 56th Ave W Suite 200
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www.ilgross.com

Project Title: Lorenzini Waterfront Home
Engineer: Mark Speidel
Project ID:
Project Descr: SFR Remodeling

Torsional Analysis of Rigid Diaphragm

Lic. # : KW-06002858 — I.L. GROSS STRUCTURAL ENGINEERS

DESCRIPTION: West Wing Diaphragm Analysis

General Information

IBC 2015, CBC 2016, ASCE 7-10

Applied Lateral Force in "X" DIrection	6.920 k	Center of Shear Application :	
Applied Lateral Force in "Y" DIrection	6.920 k	Distance from "X" datum point	43.0 ft
		Distance from "Y" datum point	14.0 ft
Note: These loads are resolved into X & Y components when applied to the system of elements at angular increments.		Accidental Torsion values per ASCE 7-05 12.8.4.2	
		Ecc. as % of Maximum Dimension	5.00 %
Load Orientation Angular Increment	15.0 deg		
Load Location Angular Increment	15.0 deg	Maximum Dimensions :	
		Along "X" Axis	86.0 ft
Center of Rigidity Location (calculated) . . .		Along "Y" Axis	24.0 ft
"X" dist. from Datum	32.467 ft		
"Y" dist. from Datum	10.025 ft		

Accidental Eccentricity +/- from "Y" Coord. of Center of Load Application : 4.30 ft

Accidental Eccentricity +/- from "X" Coord. of Center of Load Application : 1.20 ft

Wall Information

Label : SW -A.3		X Wall C.G. Location	48.5 ft	Length	11 ft
		Y Wall C.G. Location	24 ft	Height	12 ft
Wall Deflections (Stiffness) for 1.0 kip load :		Wall Angle CCW	0 deg	Thickness	6 in
Along Wall "y" Dir	8.8186E-004 in	Wall Fixity	Fix-Pin	E - Bending	1.6 Mpsi
Along Wall "x" Dir	2.6216E+004 in			E - Shear	0.64 Mpsi
Label : SW -B		X Wall C.G. Location	29 ft	Length	8.5 ft
		Y Wall C.G. Location	14 ft	Height	10 ft
Wall Deflections (Stiffness) for 1.0 kip load :		Wall Angle CCW	0 deg	Thickness	4 in
Along Wall "y" Dir	1.5692E-003 in	Wall Fixity	Fix-Pin	E - Bending	1.6 Mpsi
Along Wall "x" Dir	6.6231E+004 in			E - Shear	0.64 Mpsi
Label : SW-A.1		X Wall C.G. Location	21 ft	Length	19 ft
		Y Wall C.G. Location	24 ft	Height	12 ft
Wall Deflections (Stiffness) for 1.0 kip load :		Wall Angle CCW	0 deg	Thickness	6 in
Along Wall "y" Dir	3.0234E-004 in	Wall Fixity	Fix-Pin	E - Bending	1.6 Mpsi
Along Wall "x" Dir	1.5177E+004 in			E - Shear	0.64 Mpsi
Label : SW-A.2		X Wall C.G. Location	37 ft	Length	8 ft
		Y Wall C.G. Location	24 ft	Height	12 ft
Wall Deflections (Stiffness) for 1.0 kip load :		Wall Angle CCW	0 deg	Thickness	6 in
Along Wall "y" Dir	1.8750E-003 in	Wall Fixity	Fix-Pin	E - Bending	1.6 Mpsi
Along Wall "x" Dir	3.6047E+004 in			E - Shear	0.64 Mpsi
Label : SW-C		X Wall C.G. Location	50 ft	Length	9 ft
		Y Wall C.G. Location	10 ft	Height	12 ft
Wall Deflections (Stiffness) for 1.0 kip load :		Wall Angle CCW	0 deg	Thickness	6 in
Along Wall "y" Dir	1.4043E-003 in	Wall Fixity	Fix-Pin	E - Bending	1.6 Mpsi
Along Wall "x" Dir	3.2041E+004 in			E - Shear	0.64 Mpsi
Label : SW-D		X Wall C.G. Location	12 ft	Length	24 ft
		Y Wall C.G. Location	0 ft	Height	9 ft
Wall Deflections (Stiffness) for 1.0 kip load :		Wall Angle CCW	0 deg	Thickness	6 in
Along Wall "y" Dir	1.3916E-004 in	Wall Fixity	Fix-Pin	E - Bending	1.6 Mpsi
Along Wall "x" Dir	5.0742E+003 in			E - Shear	0.64 Mpsi
Label : SW-L		X Wall C.G. Location	25 ft	Length	17 ft
		Y Wall C.G. Location	8.5 ft	Height	12 ft
Wall Deflections (Stiffness) for 1.0 kip load :		Wall Angle CCW	90 deg	Thickness	4 in
Along Wall "y" Dir	5.5071E-004 in	Wall Fixity	Fix-Pin	E - Bending	1.6 Mpsi
Along Wall "x" Dir	5.7209E+004 in			E - Shear	0.64 Mpsi
Label : SW-M		X Wall C.G. Location	39 ft	Length	4 ft
		Y Wall C.G. Location	15 ft	Height	10 ft
Wall Deflections (Stiffness) for 1.0 kip load :		Wall Angle CCW	90 deg	Thickness	4 in
Along Wall "y" Dir	1.0938E-002 in	Wall Fixity	Fix-Pin	E - Bending	1.6 Mpsi
Along Wall "x" Dir	1.4074E+005 in			E - Shear	0.64 Mpsi

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Torsional Analysis of Rigid Diaphragm

Lic. # : KW-06002858 — I.L. GROSS STRUCTURAL ENGINEERS

DESCRIPTION: West Wing Diaphragm Analysis

Wall Information

Label : SW-N

Wall Deflections (Stiffness) for 1.0 kip load :
Along Wall "y" Dir 1.6612E-003 in
Along Wall "x" Dir 2.3854E+004 in

X Wall C.G. Location	54 ft	Length	7 ft
Y Wall C.G. Location	13.5 ft	Height	10 ft
Wall Angle CCW	90 deg	Thickness	6 in
Wall Fixity	Fix-Pin	E - Bending	1.6 Mpsi
		E - Shear	0.64 Mpsi

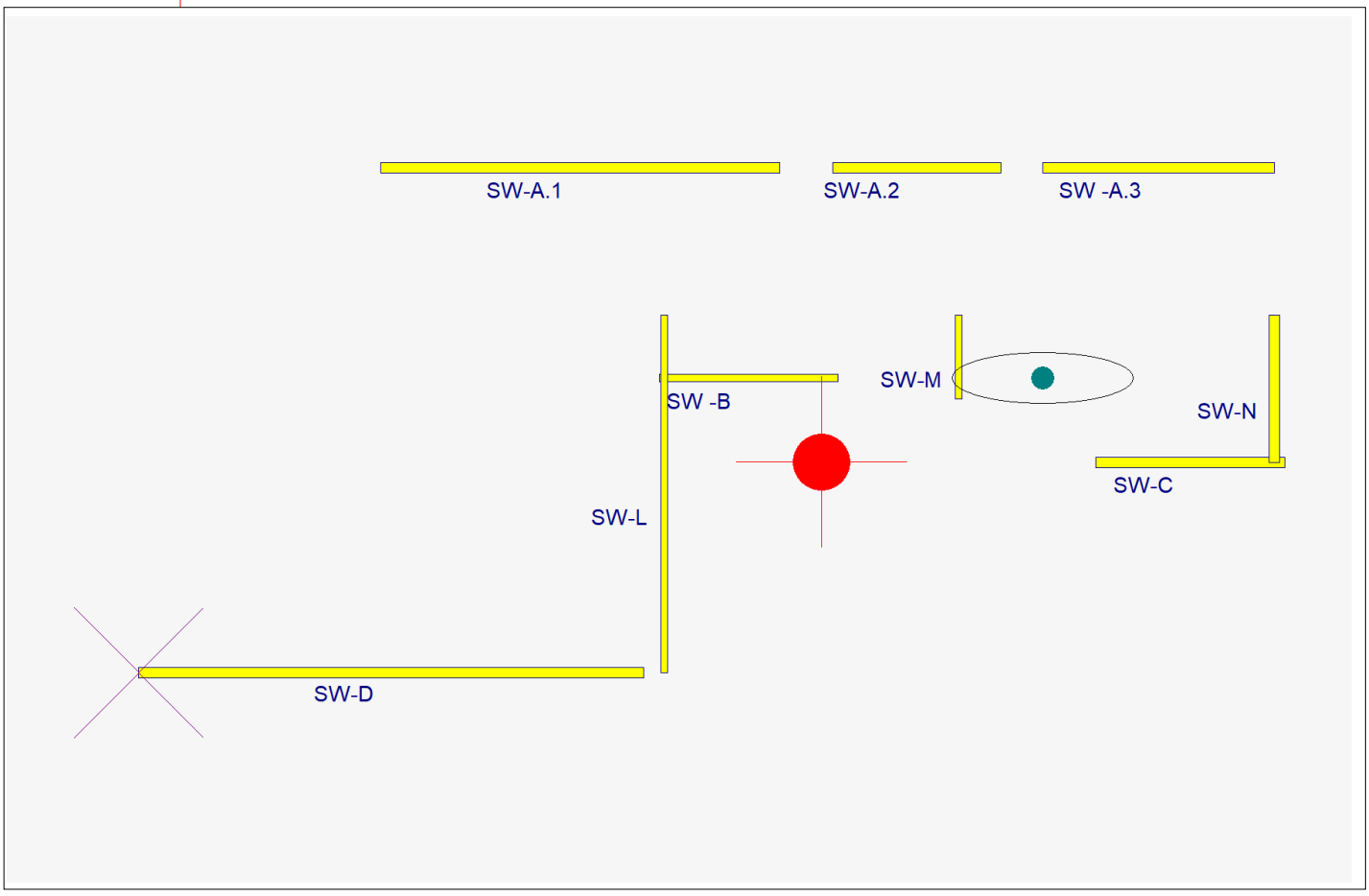
ANALYSIS SUMMARY

Maximum shear forces applied to resisting elements. Eccentricity with respect to Center of Rigidity

	Max Shear along Member Local "y-y" Axis				Max Shear along Member Local "x-x" Axis			
Resisting Element	Load Angle	X-Ecc (ft)	Y-Ecc (ft)	Shear Force (k)	Load Angle	X-Ecc (ft)	Y-Ecc (ft)	Shear Force (k)
SW -A.3	135	-14.69	4.29	1.115	90	-6.23	3.98	0.000
SW -B	345	-13.57	4.82	0.384	90	-6.23	3.98	0.000
SW-A.1	135	-14.69	4.29	3.253	90	-6.23	3.98	0.000
SW-A.2	135	-14.69	4.29	0.525	90	-6.23	3.98	0.000
SW-C	0	-6.23	3.98	0.365	90	-6.23	3.98	0.000
SW-D	0	-6.23	3.98	3.681	90	-6.23	3.98	0.000
SW-L	90	-14.83	3.98	5.674	0	-6.23	3.98	0.000
SW-M	90	-9.42	5.13	0.271	0	-6.23	3.98	0.000
SW-N	90	-9.42	5.13	2.065	0	-6.23	3.98	0.000

Layout of Resisting Elements

Legend : Defined Wall — X Datum — Center of Rigidity — Center of Mass — Accidental eccentricity application boundary



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Torsional Analysis of Rigid Diaphragm

File: Lorenzini Residence.ec6

Lic. # : KW-06002858
I.L. GROSS STRUCTURAL ENGINEERS

DESCRIPTION: West Wing Diaphragm Analysis

Analysis Notes

This program is designed to distribute an applied shear load to a set of resisting elements.

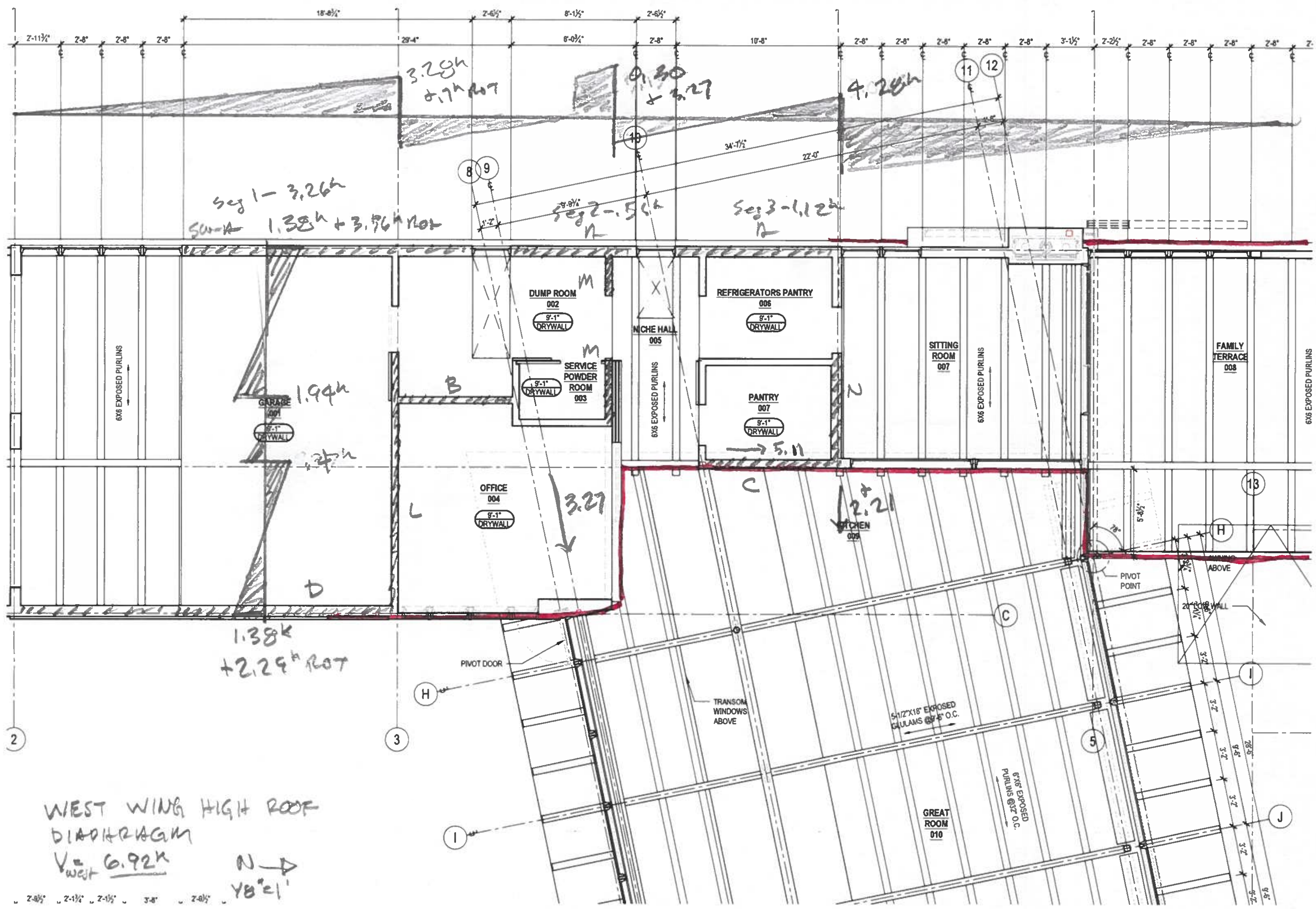
Each resisting element data entry specifies a deflection along a "major" and "minor" axis due to a 1,000 lb load. Each resisting element may be entered as a wall or a column (whereby the deflection is calculated), or as a generic resisting element with specified deflection. The deflections define the stiffness of each resisting element.

Each resisting element is defined at an (X,Y) location from a datum the user has previously defined. A counter-clockwise rotation of the element can be entered with respect to a traditional "+X" axis line.

A main "shear" load and an optional orthogonal shear load are specified for distribution to the system of resisting elements. In addition the maximum orthogonal dimensions of the structure and minimum accidental eccentricity percentage are specified.

From the entered loads the program calculates resultant force vectors for each angular orientation that is requested. The force is applied to the resisting elements in angular increments to generate a series of resulting direct and torsional shear loads on each element. This application of force is then repeated at angular intervals along an elliptical path defined by the minimum accidental eccentricity.

The end result is a table of direct shear and torsional shear values for each element from the iterated angles of load application and accidental eccentricity. These values are then searched to find the maximum major and minor axis shears applied to each resisting element.


WEST WING HIGH ROOF DIAPHRAGM
V_{west} = 6.92k
N →
Seg 1 – 3.26k
1.38k + 3.76k Rot
Seg 2 – .56k
Seg 3 – 1.12k
3.29k
4.28k
1.38k
+2.29k Rot
3.27
5.11
2.21
1.94k
GARAGE 001
DUMP ROOM 002
SERVICE POWDER ROOM 003
OFFICE 004
NICHE HALL 005
REFRIGERATORS PANTRY 006
PANTRY 007
SITTING ROOM 007
FAMILY TERRACE 008
KITCHEN 009
GREAT ROOM 010
9'-1" DRYWALL
6X6 EXPOSED PURLINS
6"X6" EXPOSED PURLINS @32" O.C.
5-1/2"X18" EXPOSED GLULAMS @9'-6" O.C.
TRANSOM WINDOWS ABOVE
PIVOT DOOR
PIVOT POINT
AWNING ABOVE
18'-8¾"
29'-4"
8'-1½"
6'-0¾"
10'-8"
34'-7½"
22'-0"
2'-8"

WEST WING ROOF DIAPHRAGM — DEFLECTION EVALUATION

$$\delta_{dia} = \frac{5vL^3}{8EAW} + \frac{0.25vL}{1000G_a} + \frac{\Sigma x \Delta_c}{2w}$$

$V_{asd} = 3.72^k/91' = 40.9$ plf

$L = 29'$ at cant end

$E = 1600000$

$A = (6\times6) = 30.25\ in^2$

$W = 24'$

$G_a = 6.5\ k/in = 6500\ \#/in$

At open end

$x = 29.5'$

$\Delta_c = M = \frac{50k'}{w=24'} \Rightarrow 2085\#$ T

16d Nails @ splice $2' = 225\#$

$\therefore$ 10 Nails Req'd for splice

$\Delta_c = \frac{2T}{\gamma n}$ w/ $\gamma = 11736$, $n = 10$

$\Delta_c = \frac{4170}{117360} = .0355"$

$$\delta_{end} = \left(\frac{5(40.9)(29'\times12)^3}{8\times1600000\times30.25\times24\times12}\right) = .022"$$

$$+ \frac{.25(40.9)(29\times12)}{1000\times6500} = .00055"$$

$$+ \frac{29.5\times12\times.0355}{2\times24\times12} = .022$$

$\delta_{end} = .099" \simeq 0.1"$

$\delta_{EW-L} = 0.15"$ (w/ ASD LOADING & $\rho = 1.0$)

$\Sigma\delta = 0.25" < 0.96"$ ✓OK $\quad \delta_{total}$ AT OPEN END $< \Delta_a$

Allowable Story Drift per ASCE7 $= .020 h_{sx} = \frac{2.88"}{C_D = 3.0} = \underline{0.96 = \Delta_a}$ ($h_{sx} = 12'$)

C_D for SWS $= 3.0$

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SHEET TITLE: OPEN DIAPHRAGM DEFLECTION	SCALE: —
DATE: 6/2021	
PROJECT: LORENZINI RES	DESIGNED BY: MARK
CLIENT: RES	CHECKED:
SHEET:	

SW - U	E/W Direction		
Roof- Upper Floor			
H=	12.0	Mot=	23.0 k-ft
L=	4.0	C=	5.8 k
Vapp=	1.9	Mres=	1.5 k-ft
WW=	0.5	T=	6.2 k
TA=	4.0	AR=	0.9
Weight=	0.2	Co=	1.0
Shear VLF=	548.6		**W4 HDU5**

CMU Wall at FP BOX

Upper- Main Floor			
H=	9.0	Mot=	49.3 k-ft
L=	6.0	C=	8.2 k
Vapp=	1.0	Mres=	6.1 k-ft
WW=	1.1	T=	7.2 k
TA=	8.0	AR=	1.1
Weight=	0.9	Co=	1.0
Shear VLF=	486.7		**W4 HDU5**

CMU Wall at FP BOX

SW - V	E/W Direction		
Roof- Upper Floor			
H=	6.0	Mot=	27.1 k-ft
L=	5.0	C=	5.4 k
Vapp=	4.5	Mres=	1.5 k-ft
WW=	0.3	T=	5.1 k
TA=	4.0	AR=	1.1
Weight=	0.3	Co=	1.0
Shear VLF=	904.0		**W2 HDU4**

Upper- Main Floor			
H=	9.0	Mot=	79.5 k-ft
L=	6.0	C=	13.3 k
Vapp=	1.3	Mres=	5.6 k-ft
WW=	0.9	T=	12.3 k
TA=	8.0	AR=	1.1
Weight=	1.0	Co=	1.0
Shear VLF=	970.0		**W2 HDU11**

SW - X	N/S Direction		
Roof- Main Floor			
H=	8.0	Mot=	8.8 k-ft
L=	4.5	C=	2.0 k
Vapp=	1.1	Mres=	1.2 k-ft
WW=	0.4	T=	1.7 k
TA=	2.5	AR=	1.0
Weight=	0.1	Co=	1.0
Shear VLF=	244.4		**W6 HDU2**

SW - Y	E/W Direction		
Roof- Main Floor			
H=	9.0	Mot=	19.8 k-ft
L=	6.0	C=	3.3 k
Vapp=	2.2	Mres=	2.7 k-ft
WW=	0.6	T=	2.9 k
TA=	4.0	AR=	1.1
Weight=	0.3	Co=	1.0
Shear VLF=	366.7		**W6 HDU2**

SW - Z	N/S Direction		
Roof- Main Floor			
H=	9.0	Mot=	11.7 k-ft
L=	6.0	C=	2.0 k
Vapp=	1.3	Mres=	2.3 k-ft
WW=	0.6	T=	1.6 k
TA=	2.5	AR=	1.1
Weight=	0.2	Co=	1.0
Shear VLF=	216.7		**W6 HDU2**

SW - AA	E/W Direction		
Terrace- Basement			
H=	9.0	Mot=	5.4 k-ft
L=	7.0	C=	0.8 k
Vapp=	0.6	Mres=	3.7 k-ft
WW=	0.7	T=	0.4 k
TA=	4.0	AR=	1.1
Weight=	0.4	Co=	0.7
Shear VLF=	122.4		**W6 ABs ok**

HDU11 Holdown – ASD load conversion CHECKS

HOLDOWN CAPACITY FROM SIMPSON LCC REPORTED 9535# w/ C_D 1.60

CAPACITY/C_D = 5960#

LRFD CONVERSION $K_F = 2.16/\phi$ FOR CONNECTIONS

w/ ϕ = 0.8 for SW DESIGN K_F = 2.7

5960# × (K_F = 2.7) = 16090# UPLIFT CAPACITY FOR UPLIFT w/ HDU11

ALTERNATIVELY, REUSE SW # OF LOADS FOR ASD 0.7E SHEAR

FOR SW-V: $V_{HR} = 4.5^k \times .7 = 3.15$, H = 14', L = 6'

$V_{LR} = 1.3^k \times 0.7 = 0.91^k$, H = 9' L = 6'

$M_{OT} = 3.15^k \times 14' + 0.91^k \times 9' = 52.30^{k'}$

ASD DL Resistance = 0.6D

HR DL = 216#
Wall DL = 198#
LR DL = 302#
Wall DL = 324#

ΣDL = 1040# ∴ $M_{RES} = 3.12^{k'}$

$T = \frac{52.3^{k'} - 3.1^{k'}}{6'} = 8.2^k < 9.5^k$ → HDU11 is OK

$C = \frac{52.3^{k'} + 3.1^{k'}}{6'} = 9.23^k$ (3) 2x6 OR

OR 4x6 POST IN 2x4 WALL

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HDU11 check at SW-V — SHEET TITLE
Lorenzini — PROJECT
RES — CLIENT
SCALE
DESIGNED BY
CHECKED
DATE
SHEET

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