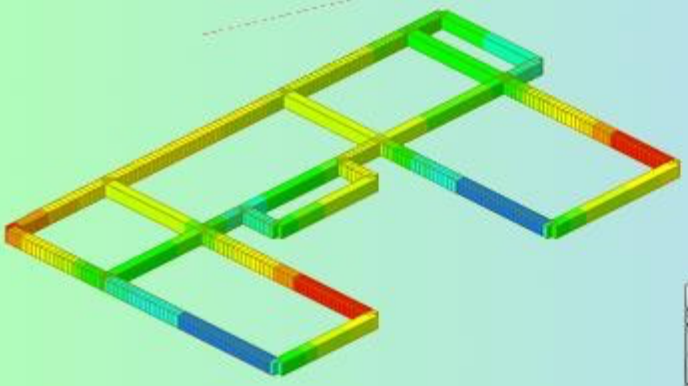
EME AL CUBO

Wonderful Structures

GENERAL FOUNDATION ANALYSIS



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STRUCTURAL REPORT

GENERAL FOUNDATION ANALYSIS

1. SCOPE

This report aims to provide a general assessment of the foundation construction system and technology of Wonderful Structures eco-green structures. Since 2016 these structures have been evaluated, featuring different geometries, applications, locations, and subjected to varying environmental and seismic conditions. Based on this experience, we present the verification of the foundation system for a typical geometry that includes the basic modules forming the modular panel structure and is subjected to typical loads encountered in different projects. The intention is to verify the standard foundation being utilized in these structures.

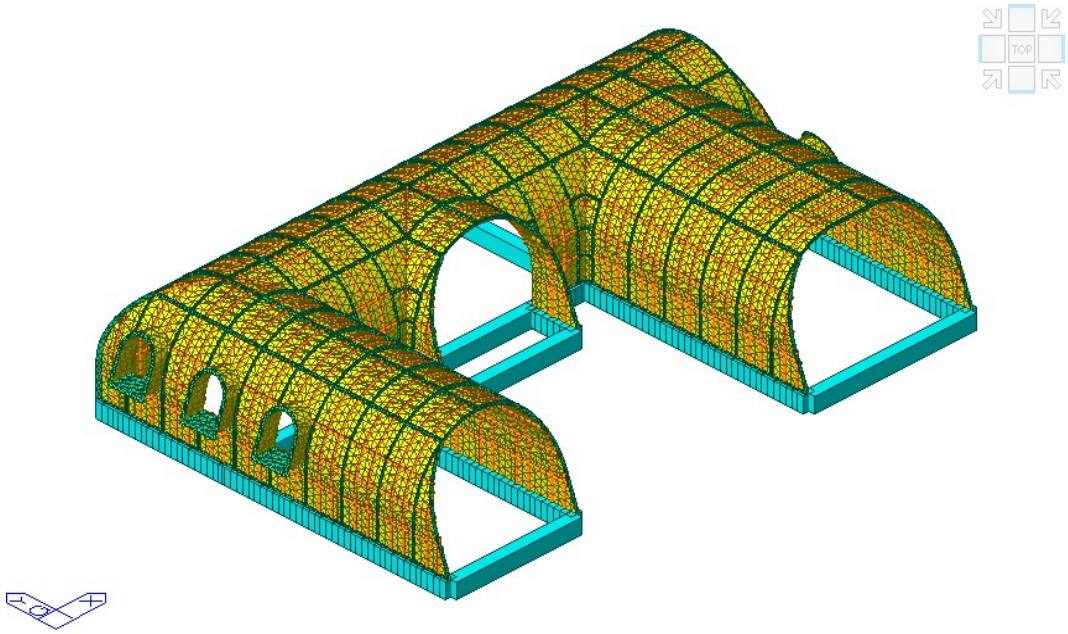


Figure 1. Finite Elements Model for foundation analysis.

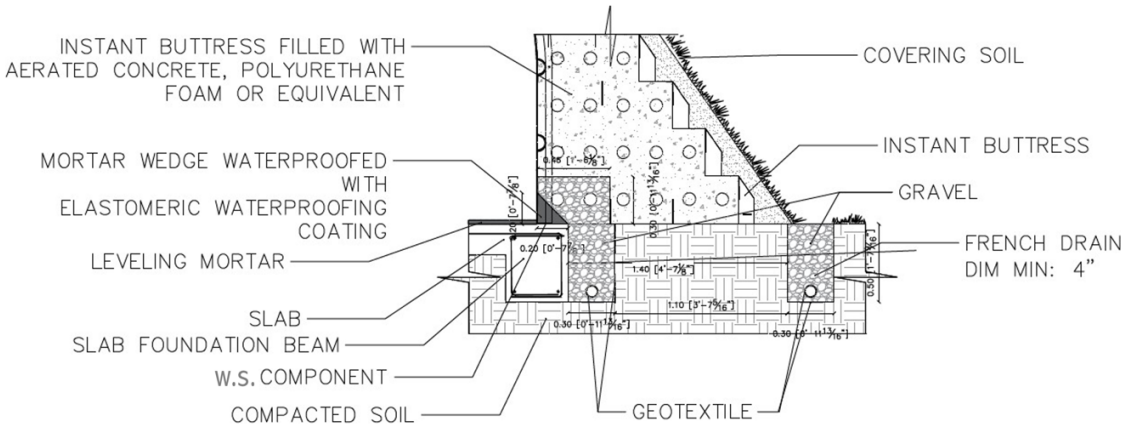


Figure 2. Typical foundation section.

Therefore, a finite element model is developed for the evaluation of the soil pressure and forces in the grade beams. According to the information provided by "Wonderful Structures" the typical foundation system is a

40x50cm beam. This beam is adequate when considering: (1) Concrete with compressive strength of 4,000psi, (2) Include beams under the doors and continuity of the main ones and (3) include at least 3 #5 bars top and bottom.

In the load assessment, the effect of incorporating either instant buttresses or geofoam blocks has been taken into account.

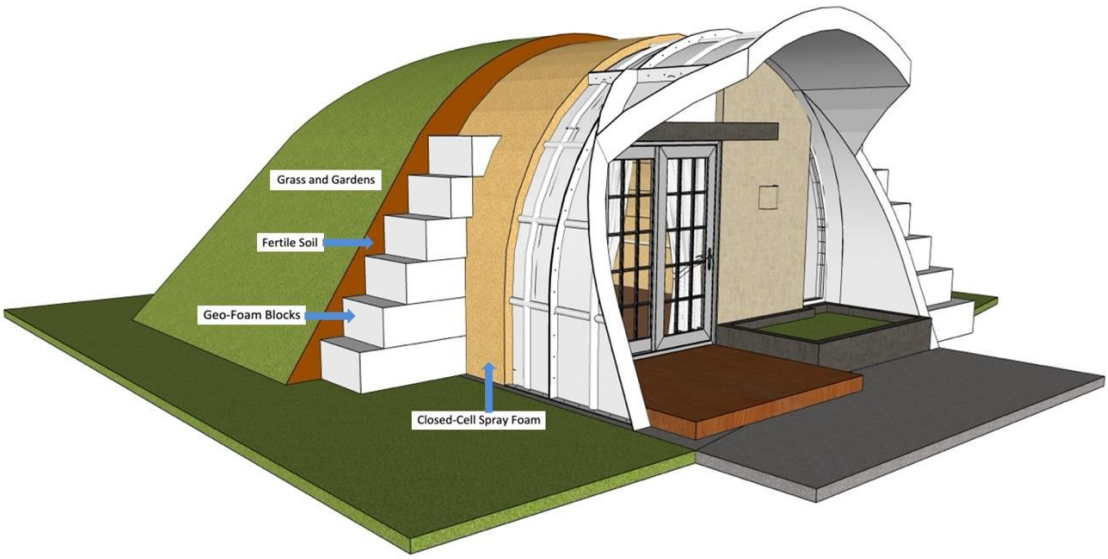


Figure 3. Geo-foam blocks

2. LOADS

2.1. Vertical and wind Loads

CASE	CONDITION
DEAD	3.7 kPa
LIVE	2.0 kPa
WIND SPEED	107 mph
GROUND SNOW LOAD	1.77 kPa
SEISMIC LOAD	RESPONSE SPECTRUM R=2.0

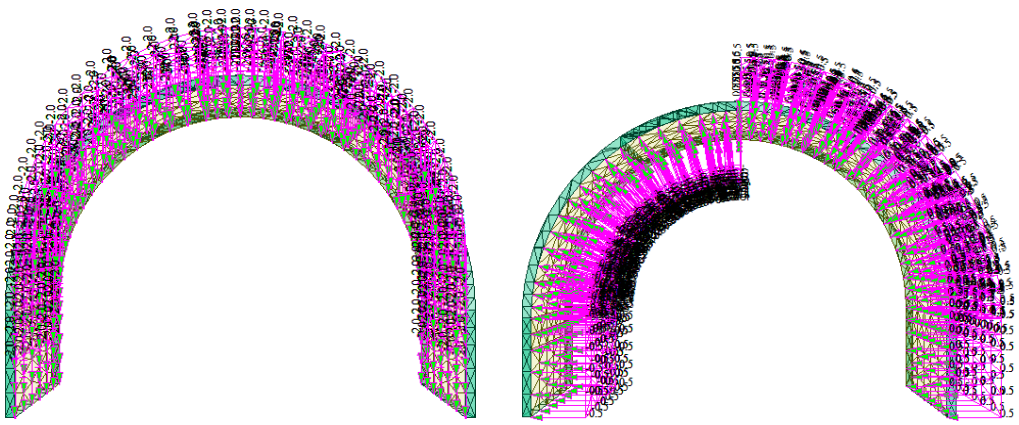
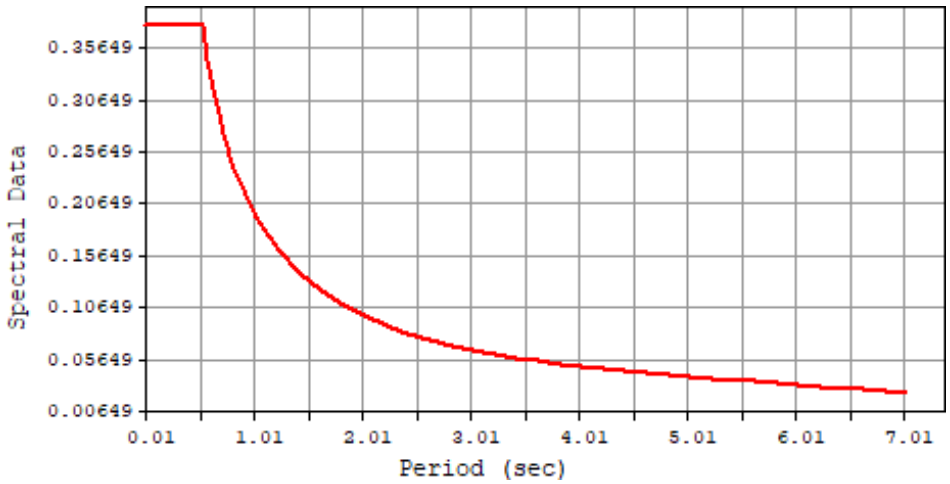


Figure 4. Typical wind load applications over the structure.

2.2. Seismic response spectrum



2.3. Load combinations

1	gLCB1	1.4D	18	gLCB24	(D)
2	gLCB2	1.2(D) + 1.6(L) + 0.5S	19	gLCB25	(D) + L
3	gLCB3	1.2D + 1.6S + 1.0L	20	gLCB26	(D) + S
4	gLCB4	1.2D + 1.6S + 0.5Wx{+}	21	gLCB27	(D) + 0.75L + 0.75S
5	gLCB5	1.2D + 1.6S + 0.5Wy{+}	22	gLCB28	(D) + 0.6Wx{+}
6	gLCB8	1.2D + 1.0Wx{+} + 1.0L + 0.5S	23	gLCB29	(D) + 0.6Wy{+}
7	gLCB9	1.2D + 1.0Wy{+} + 1.0L + 0.5S	24	gLCB32	(D) + 0.7(1.0)Ex(R=2)
8	gLCB12	1.2D + 1.0(1.0)Ex(R=2) + 1.0L + 0.2S	25	gLCB33	(D) + 0.7(1.0)Ey(R=2)
9	gLCB13	1.2D + 1.0(1.0)Ey(R=2) + 1.0L + 0.2S	26	gLCB34	(D) - 0.7(1.0)Ex(R=2)
10	gLCB14	1.2D - 1.0(1.0)Ex(R=2) + 1.0L + 0.2S	27	gLCB35	(D) - 0.7(1.0)Ey(R=2)
11	gLCB15	1.2D - 1.0(1.0)Ey(R=2) + 1.0L + 0.2S	28	gLCB36	(D) + 0.75L + 0.75(0.6)Wx{+} + 0.75S
12	gLCB16	0.9D + 1.0Wx{+}	29	gLCB37	(D) + 0.75L + 0.75(0.6)Wy{+} + 0.75S
13	gLCB17	0.9D + 1.0Wy{+}	30	gLCB40	(D) + 0.75L + 0.75(0.7(1.0)Ex(R=2)) + 0.75S

14	gLCB20	0.9D + 1.0(1.0)Ex(R=2)
15	gLCB21	0.9D + 1.0(1.0)Ey(R=2)
16	gLCB22	0.9D - 1.0(1.0)Ex(R=2)
17	gLCB23	0.9D - 1.0(1.0)Ey(R=2)
31	gLCB41	(D) + 0.75L + 0.75(0.7(1.0)Ey(R=2)) + 0.75S
32	gLCB42	(D) + 0.75L - 0.75(0.7(1.0)Ex(R=2)) + 0.75S
33	gLCB43	(D) + 0.75L - 0.75(0.7(1.0)Ey(R=2)) + 0.75S
34	gLCB44	0.6D + 0.6Wx{+}
35	gLCB45	0.6D + 0.6Wy{+}
36	gLCB48	0.6(D) + 0.7(1.0)Ex(R=2)
37	gLCB49	0.6(D) + 0.7(1.0)Ey(R=2)
38	gLCB50	0.6(D) - 0.7(1.0)Ex(R=2)
39	gLCB51	0.6(D) - 0.7(1.0)Ey(R=2)

3. SOIL PRESSURES

As can be seen in this analysis, for any of the cases evaluated the soil bearing capacity of 2.000 psf, is not exceeded.

Note: *In this chapter the deformed shape of the superstructure is shown for reference only. The Scope of this analysis does not include the evaluation of the strength of the superstructure.*

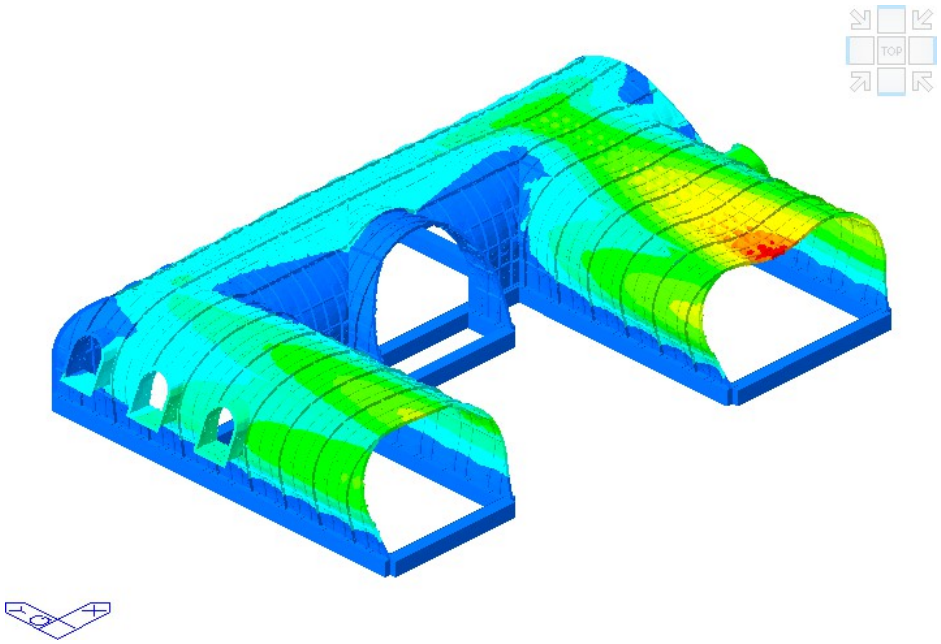


Figure 5. Structural deformed shape for envelope of service load combinations.

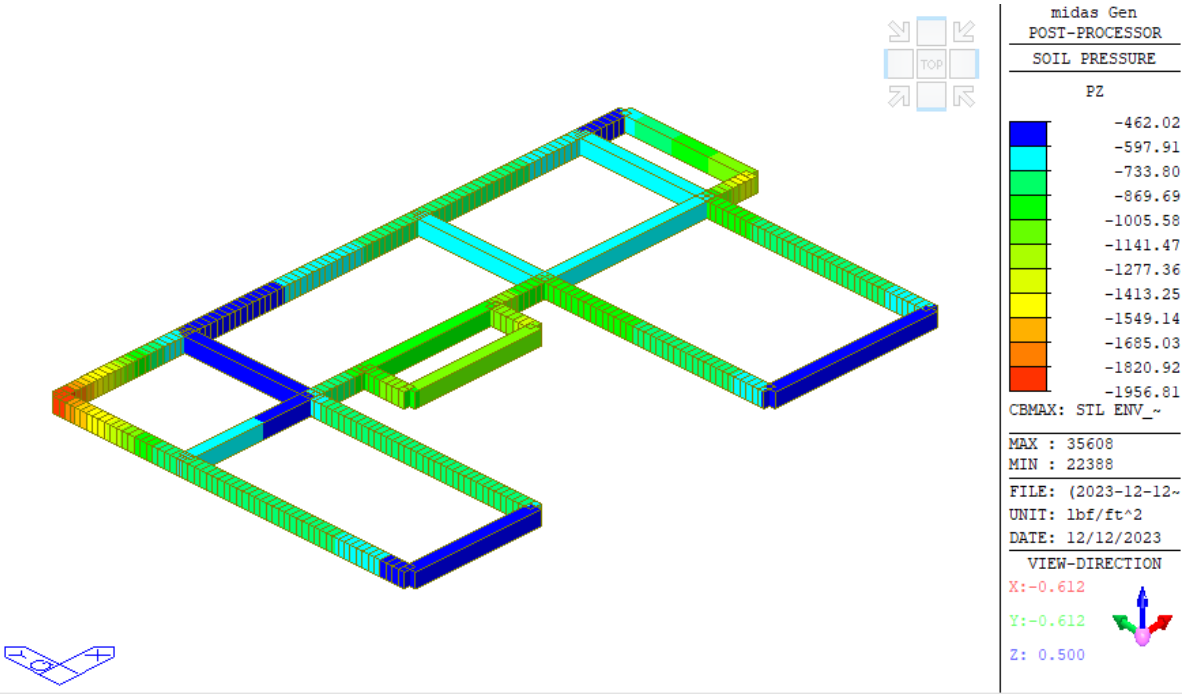


Figure 6. Soil pressure due to envelope of service load combinations.

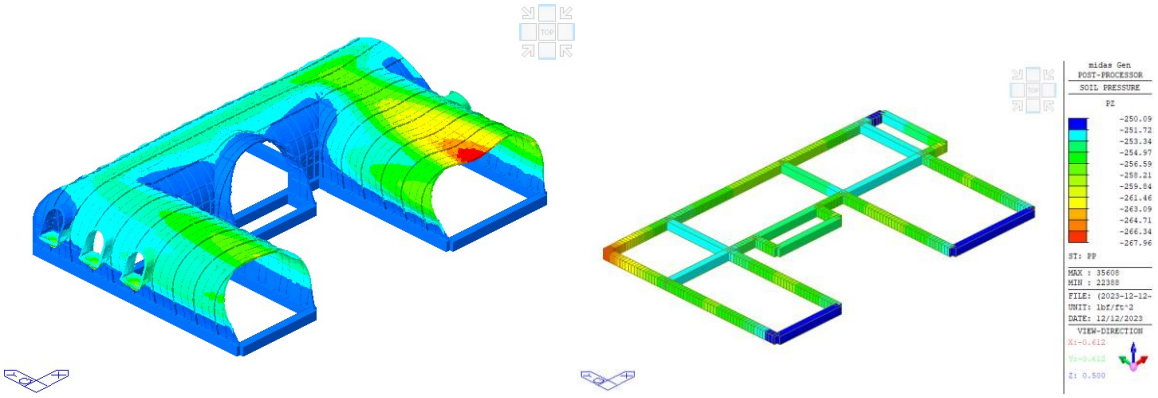


Figure 7. Soil pressure due to self-weight load.

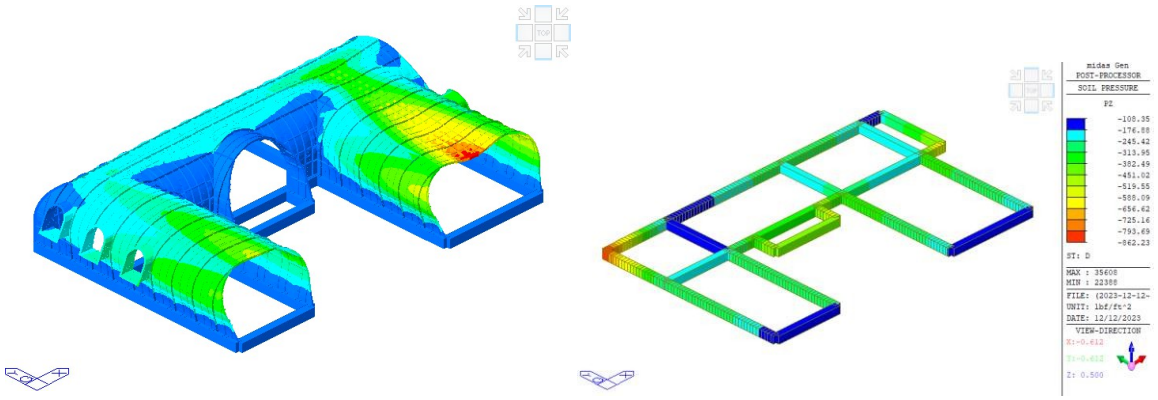


Figure 8. Soil pressure due to dead load.

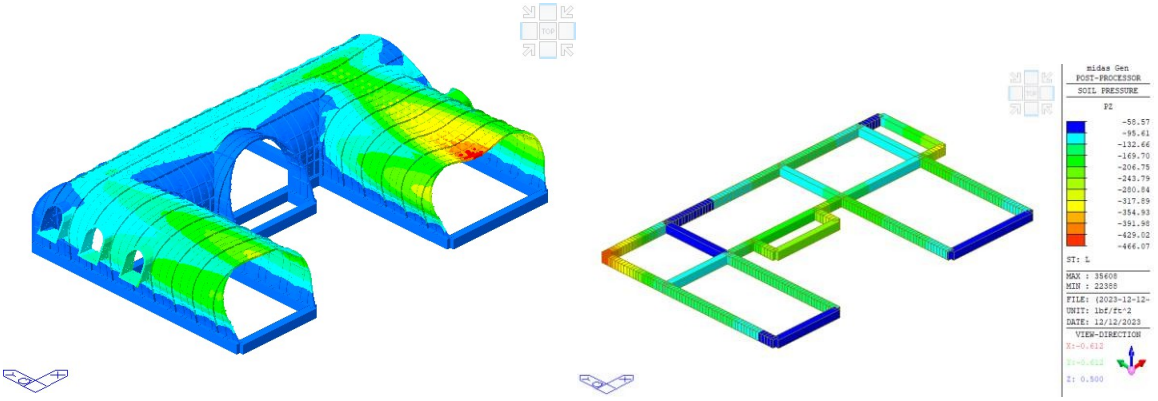


Figure 9. Soil pressure due to live load.

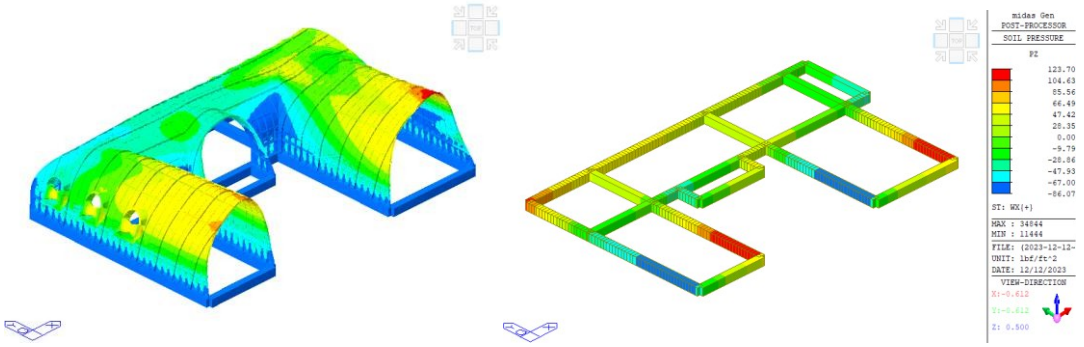


Figure 10. Soil pressure due to wind in X direction.

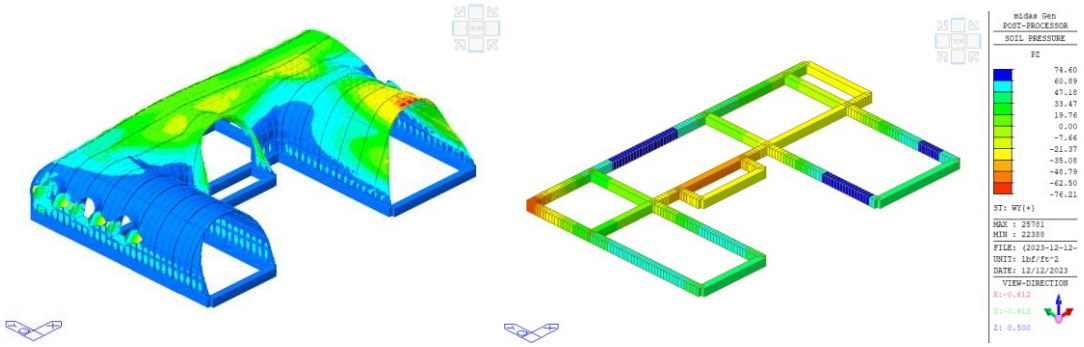


Figure 11. Soil pressure due to wind in Y direction.

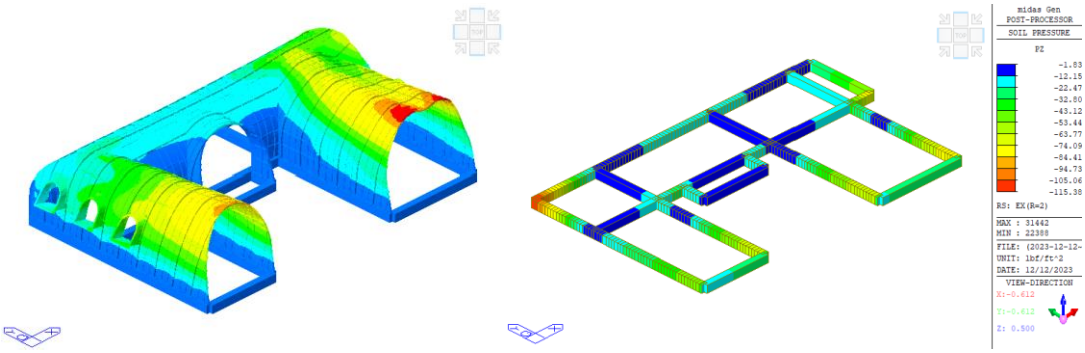


Figure 12. Soil pressure due to Seismic load in X direction.

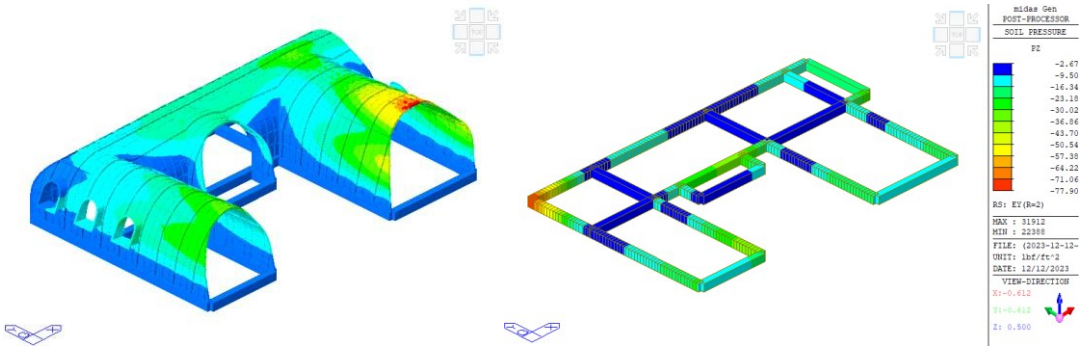


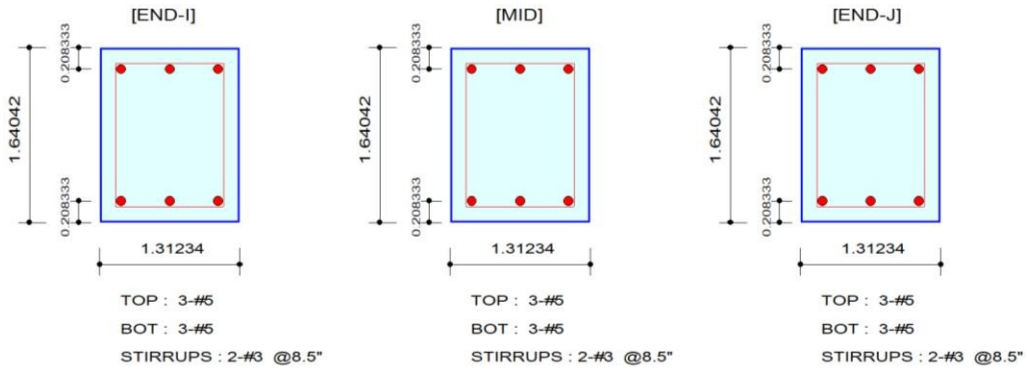
Figure 13. Soil pressure due to Seismic load in Y direction.

4. CONCRETE ELEMENTS CHECK

1. Design Information

Design Code	: ACI318-14	Unit System	: lbf, ft
Material Data	: fc = 576000, fy = 8.64e+006, fys = 8.64e+006 psf		
Section Property	: VC(40x50) (No : 2)	Beam Span	: 27.7231 ft

2. Section Diagram



3. Bending Moment Capacity

	END-I	MID	END-J
(-) Load Combination No.	3	3	3
Moment (Mu)	63215.00	28893.56	30003.49
Factored Strength (PhiMn)	69738.70	69738.70	69738.70
Check Ratio (Mu/PhiMn)	0.9065	0.4143	0.4302
(+) Load Combination No.	3	3	3
Moment (Mu)	35807.60	31798.05	31299.15
Factored Strength (PhiMn)	69738.70	69738.70	69738.70
Check Ratio (Mu/PhiMn)	0.5135	0.4560	0.4488
Required Rebar Top (As_top)	0.0063	0.0035	0.0036
Required Rebar Bot (As_bot)	0.0044	0.0039	0.0038

4. Shear Capacity

	END-I	MID	END-J
Load Combination No.	3	3	3
Factored Shear Force (Vu)	24060.09	22200.33	16557.59
Shear Strength by Conc.(PhiVc)	25674.27	25674.27	25674.27
Shear Strength by Rebar.(PhiVs)	20015.52	20015.52	20015.52
Required Shear Reinf. (AsV)	0.0011	0.0011	0.0011
Required Stirrups Spacing	2-#3 @8.5"	2-#3 @8.5"	2-#3 @8.5"
Check Ratio	0.5266	0.4859	0.3624

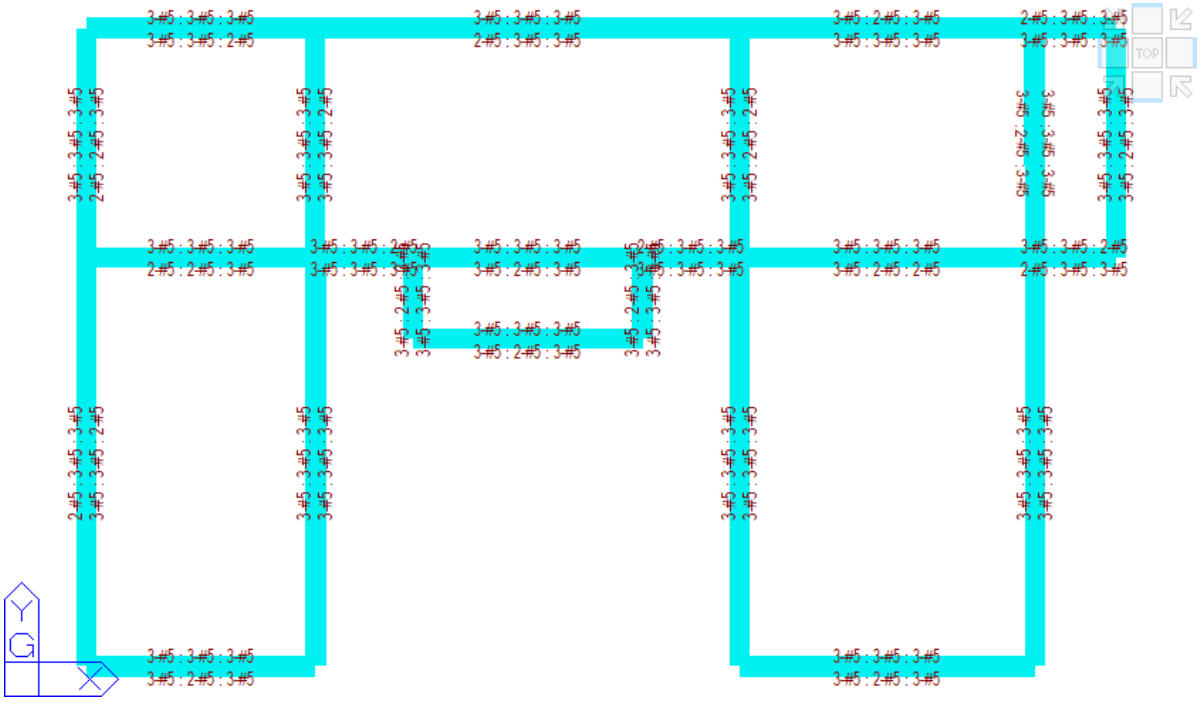


Figure 14.Minimum longitudinal rebar distribution - Plan view.

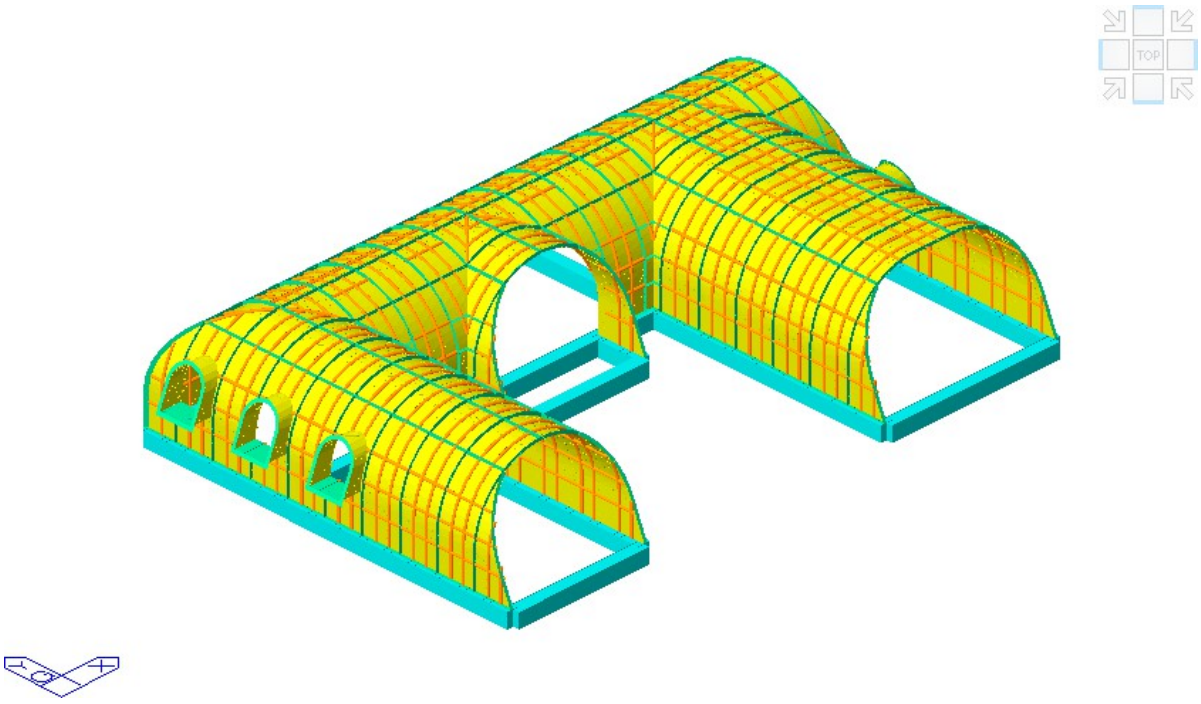


Figure 15 Finite Elements Model for foundation analysis.

5. CONCLUSIONS

The proposed foundation system, consisting of a continuous footing beam beneath the panels, exhibits suitable behavior provided that the following conditions are met:

- The tie beams beneath the doors are included to ensure a uniform distribution of stiffness throughout the foundation system.
- The load-bearing capacity meets or exceeds 2,000 psf.

Basic recommendations from the seismic-resistant codes applicable to each construction sector must be considered. It is particularly emphasized that:

- The foundation must rest on soil that is 100% free of organic material and susceptible to decomposition. In areas lacking such natural soil at the surface level, soil replacement must be conducted until the desired soil layer is reached.
- In regions where soil freezing is a possibility, soil improvement must be carried out to the level stipulated by the relevant standards for each sector.
- In cases where unusually severe environmental conditions are present, structural evaluation must be performed for each specific scenario.