

STRUCTURAL CALCULATIONS PT FOUNDATION ONLY

For

**NIELSEN RESIDENCE
1777 CRYSTAL SPRINGS ROAD
SANTA ROSA, CA**

Prepared For

**Raymond Nielsen
1777 Crystal Springs Road
Santa Rosa, CA**

By

**XL Engineering
13620 Lincoln Way, Suite 200
Auburn, CA 95603**



Revisions:

Date: 9/18/20

Reason: First Submittal

Soils Criteria

Criteria listed here is from the soils report prepared by PJC & Associates, Inc. (Job No. 9398.01 dated March 9, 2019)

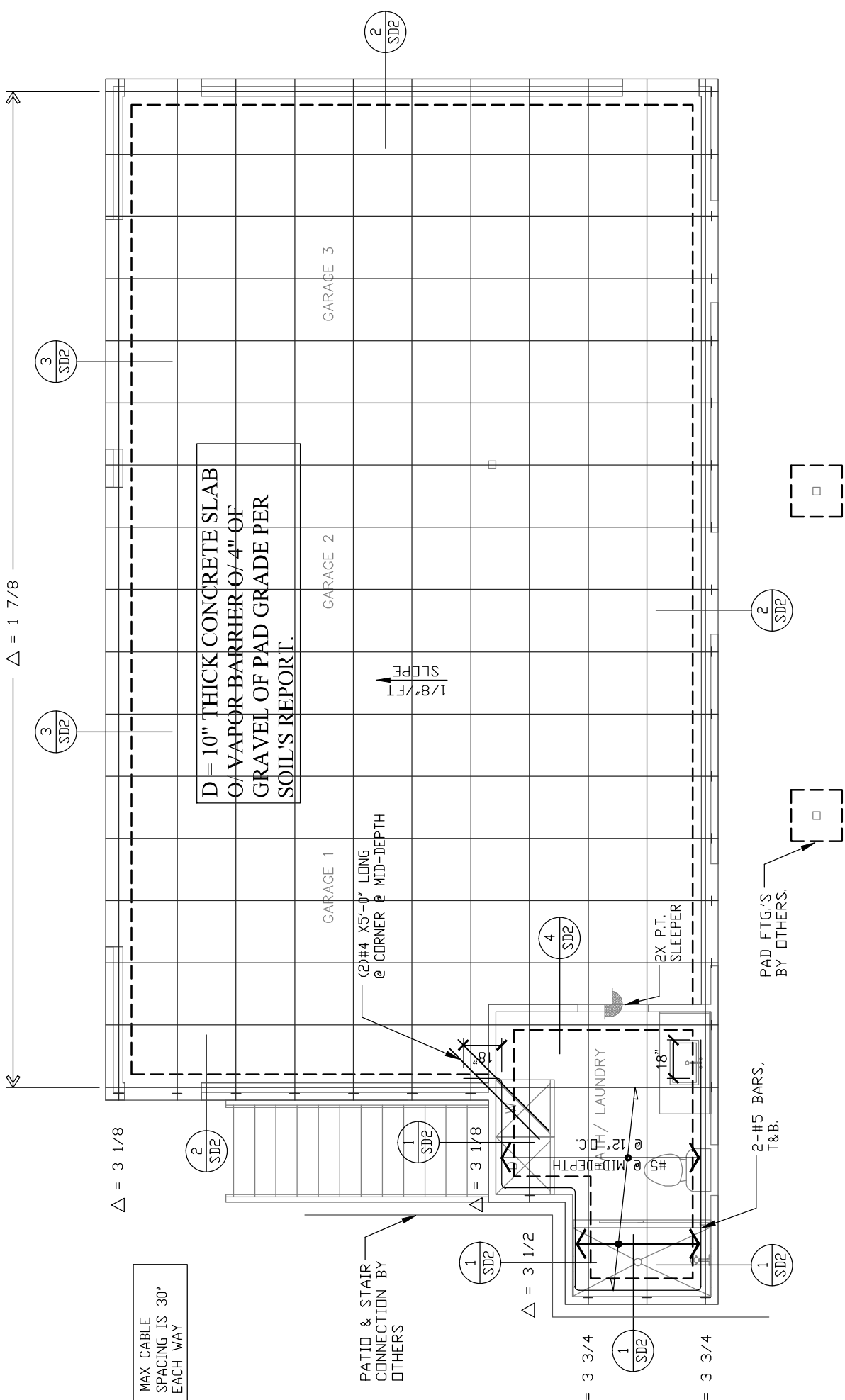
Bearing: 1500 psf for combined dead plus live load

Minimum P.T. Slab Thickness: 10"

Post Tension Design Criteria:

- **Center Lift:**
Edge Moisture Distance (em) = 7.0 feet
Soil Differential Movement (ym) = 1.9 inches
- **Edge Lift:**
Edge Moisture Distance (em) = 3.0 feet
Soil Differential Movement (ym) = 0.7 inches

Concrete Fc': 3000 psi



FOUNDATION PLAN

NOTE: SEE ARCH. SHEET FOR DIM. INFO.

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Geostructural Tool Kit, Inc.

Registered To : XL Engineering

Serial Number : 100-350-189

Project Title : 1777 Crystal Springs Rd.
Project Engineer :

Project Number :
Project Date : September 14, 2020
Report Date : March 9, 2019
Report Number : 9398.01

Geotechnical Report : PJC & Assoc., Inc.

RIBBED FOUNDATION - DESIGN SUMMARY

Slab Dimensions : 24.00 FT x 40.00 FT x 4.00 Inches

Material Properties

Concrete Strength, f'_c :	3,000 PSI
Tendon Strength, F_{pu} :	270 KSI
Tendon Diameter :	1 / 2 Inch

Material Quantities

Concrete Volume :	22.2 Cubic Yards
Prestressing Tendon :	418 Linear Feet
Number of End Anchorages :	26

In the LONG direction ...

	<u>Type I Beam</u>	<u>Type II Beam</u>
Quantity of Beams :	5	0
Depth of Beams :	13.5 Inches	0.0 Inches
Width of Beams :	12.0 Inches	0.0 Inches
Tendons per Beam :	0	0
Beam Tendon Centroid :	3.25 Inches	0.00 Inches
Beam Spacing :		6.00 Feet O.C.
Number of Slab Tendons :		3
Slab Tendon Spacing :		10.00 Feet O.C.
Slab Tendon Centroid :		2.00 Inches from top of slab

In the SHORT direction ...

	<u>Type I Beam</u>	<u>Type II Beam</u>
Quantity of Beams :	8	0
Depth of Beams :	13.5 Inches	0.0 Inches
Width of Beams :	12.0 Inches	0.0 Inches
Tendons per Beam :	0	0
Beam Tendon Centroid :	3.25 Inches	0.00 Inches
Beam Spacing :		6.00 Feet O.C.
Number of Slab Tendons :		5
Slab Tendon Spacing :		9.00 Feet O.C.
Slab Tendon Centroid :		2.00 Inches from top of slab

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RIBBED FOUNDATION - DESIGN COMPLIANCE SUMMARY

The **BOLD** values exceed allowable or are less than minimum limits by the percentage indicated:

CENTER LIFT MODE :

ALL VALUES WITHIN ALLOWABLE LIMITS.

EDGE LIFT MODE :

ALL VALUES WITHIN ALLOWABLE LIMITS.

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RIBBED FOUNDATION - RESULTS OF ANALYSIS

Soil Bearing Analysis

Section 6.2.4 of PTI DC10.5-12 Standard states:

Applied soil bearing pressure shall be evaluated using generally accepted techniques and shall not exceed qallow as specified by the Licensed Design Professional with geotechnical experience.

Prestress Summary

Subgrade Friction calculated by method prescribed in PTI Manual

	Short Direction	Long Direction
Number of Slab Tendons	5	3
Number of Beam Tendons	3	2
Spacing of Slab Tendons (Feet)	9.00	10.00
Center of Gravity of Concrete (from top of slab) (Inch)	4.17	4.23
Center of Gravity of Tendons (from top of slab) (Inch)	5.22	5.30
Eccentricity of Prestressing (Inch)	-1.05	-1.07
Minimum Effective Prestress Force (K)	180.4	100.6
Beta Distance Effective Prestress Force (K)	193.4	122.7
Minimum Effective Prestress (PSI)	64	58
Beta Distance Effective Prestress (PSI)	68	71

Moment Analysis - Center Lift Mode

Maximum Moment, Short Direction 5.39 FT-K/FT
Maximum Moment, Long Direction 4.97 FT-K/FT

	Tension in Top Fiber (KSI)			Compression in Bottom Fiber (KSI)	
	Short Direction	Long Direction		Short Direction	Long Direction
Allowable Stress	-0.329	-0.329	Allowable Stress	1.350	1.350
Actual Stress	-0.241	-0.214	Actual Stress	0.760	0.696

Stiffness Analysis - Center Lift Mode

Based on a Stiffness Coefficient of 360

	Short Direction	Long Direction
Available Moment of Inertia (Inch ⁴)	37,591	23,197
Required Moment of Inertia (Inch ⁴)	14,897	13,202
Required Moment of Inertia controlled by	Width	6*Beta

Shear Analysis - Center Lift Mode

Maximum Shear, Short Direction. 1.23 K/FT
Maximum Shear, Long Direction 0.98 K/FT

	Short Direction	Long Direction
Allowable Shear Stress (PSI)	145	146
Actual Shear Stress (PSI)	38	29

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RIBBED FOUNDATION - RESULTS OF ANALYSIS continued

Cracked Section Analysis - Center Lift Mode

	Short Direction	Long Direction
Cracked Section Capacity (FT-K)	124.5	74.8
0.5 Moment (FT-K)	107.8	59.7

Moment Analysis - Edge Lift Mode

Maximum Moment, Short Direction	1.75 FT-K/FT
Maximum Moment, Long Direction	1.84 FT-K/FT

	Tension in Bottom Fiber (KSI)			Compression in Top Fiber (KSI)	
	Short Direction	Long Direction		Short Direction	Long Direction
Allowable Stress	-0.329	-0.329	Allowable Stress	1.350	1.350
Actual Stress	-0.090	-0.089	Actual Stress	0.139	0.144

Stiffness Analysis - Edge Lift Mode

Based on a Stiffness Coefficient of 720

	Short Direction	Long Direction
Available Moment of Inertia (Inch ⁴)	37,591	23,197
Required Moment of Inertia (Inch ⁴)	9,659	9,788
Required Moment of Inertia controlled by	Width	6*Beta

Shear Analysis - Edge Lift Mode

Maximum Shear, Short Direction	1.27 K/FT
Maximum Shear, Long Direction	1.32 K/FT

	Short Direction	Long Direction
Allowable Shear Stress (PSI)	145	146
Actual Shear Stress (PSI)	39	39

Cracked Section Analysis - Edge Lift Mode

	Short Direction	Long Direction
Cracked Section Capacity (FT-K)	72.5	45.3
0.5 Moment (FT-K)	34.9	22.1

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RIBBED FOUNDATION - SELECTED VARIABLES

	Short Direction	Long Direction
Cross Sectional Area (Inch ²) :	2,832	1,722
Moment of Inertia (Inch ⁴) :	37,591	23,197
Section Modulus, Top (Inch ³) :	9,006	5,478
Section Modulus, Bottom (Inch ³) :	4,031	2,504
Center of Gravity of Concrete - from top (Inch) :	4.17	4.23
Center of Gravity of Prestressing Tendons - from top (Inch) :	5.22	5.30
Eccentricity of Prestress (Inch) :	-1.05	-1.07
Beta Distance (Feet) :	7.22	6.40
Jacking Force :	33.05 KIPS	

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UNIFORM THICKNESS FOUNDATION - DESIGN SUMMARY

Slab Dimensions : 24.00 FT x 40.00 FT x 10.00 Inches
Uniform Thickness Slab : 10.00 (9.89) Inches
(rounded to the nearest 0.25 inch)

Material Properties

Concrete Strength, f'_c : 3,000 PSI
Tendon Strength, F_{pu} : 270 KSI
Tendon Diameter : 1 / 2 Inch

Material Quantities

Concrete Volume : 29.6 Cubic Yards
Prestressing Tendon : 700.0 Linear Feet
Number of End Anchorages : 44

In the LONG direction ...

Number of Slab Tendons : 8
Slab Tendon Spacing : 3.14 Feet O.C.
Slab Tendon Centroid : 5.00 Inches from top of slab

In the SHORT direction ...

Number of Slab Tendons : 14
Slab Tendon Spacing : 2.92 Feet O.C.
Slab Tendon Centroid : 5.00 Inches from top of slab

Selected Variables

	Short Direction	Long Direction
Cross Sectional Area (Inch ²) :	4,800	2,880
Moment of Inertia (Inch ⁴) :	40,000	24,000
Section Modulus, Top and Bottom (Inch ³) :	8,000	4,800
Beta Distance (Feet) :	7.33	6.45
Jacking Force :	33.05 KIPS	

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UNIFORM THICKNESS FOUNDATION - DESIGN COMPLIANCE SUMMARY

The **BOLD** values exceed allowable or are less than minimum limits by the percentage indicated:

RIBBED FOUNDATION COMPLIANCE :

RIBBED FOUNDATION IN COMPLIANCE.

CENTER LIFT MODE :

ALL VALUES WITHIN ALLOWABLE LIMITS.

EDGE LIFT MODE :

ALL VALUES WITHIN ALLOWABLE LIMITS.

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UNIFORM THICKNESS FOUNDATION - RESULTS OF ANALYSIS

Uniform Thickness Slab **10.00 (9.89) Inches**
(rounded to nearest 0.25 inch)

Prestress Summary

Subgrade Friction calculated by method prescribed in PTI Manual

	Short Direction	Long Direction
Number of Tendons	14	8
Spacing of Tendons (FT)	2.92	3.14
Center of Gravity of Concrete (from top of slab) (Inch)	5.00	5.00
Center of Gravity of Tendons (from top of slab) (Inch)	5.00	5.00
Eccentricity of Prestressing (Inch)	0.00	0.00
Minimum Effective Prestress Force (K)	329.2	169.5
Beta Distance Effective Prestress Force (K)	346.1	198.9
Minimum Effective Prestress (PSI)	69	59
Beta Distance Effective Prestress (PSI)	72	69

Moment Analysis - Center Lift Mode

Maximum Moment, Short Direction 5.39 FT-K/FT
Maximum Moment, Long Direction 4.97 FT-K/FT

	Tension in Top Fiber (KSI)			Compression in Bottom Fiber (KSI)	
	Short Direction	Long Direction		Short Direction	Long Direction
Allowable Stress	-0.329	-0.329	Allowable Stress	1.350	1.350
Actual Stress	-0.251	-0.229	Actual Stress	0.395	0.367

Stiffness Analysis - Center Lift Mode

Based on a Stiffness Coefficient of 360

	Short Direction	Long Direction
Available Moment of Inertia (Inch ⁴)	40,000	24,000
Required Moment of Inertia (Inch ⁴)	14,897	13,315
Required Moment of Inertia controlled by	Width	6*Beta

Shear Analysis - Center Lift Mode

Maximum Shear, Short Direction 1.23 K/FT
Maximum Shear, Long Direction 0.98 K/FT

	Short Direction	Long Direction
Allowable Shear Stress (PSI)	146	145
Actual Shear Stress (PSI)	10	8

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UNIFORM THICKNESS FOUNDATION - RESULTS OF ANALYSIS continued

Cracked Section Analysis - Center Lift Mode

	Short Direction	Long Direction
Cracked Section Capacity (FT-K)	150.6	86.2
0.5 Moment (FT-K)	107.8	59.7

Moment Analysis - Edge Lift Mode

Maximum Moment, Short Direction	1.75 FT-K/FT
Maximum Moment, Long Direction	1.84 FT-K/FT

	Tension in Bottom Fiber (KSI)			Compression in Top Fiber (KSI)	
	Short Direction	Long Direction		Short Direction	Long Direction
Allowable Stress	-0.329	-0.329	Allowable Stress	1.350	1.350
Actual Stress	-0.033	-0.042	Actual Stress	0.177	0.180

Stiffness Analysis - Edge Lift Mode

Based on a Stiffness Coefficient of 720

	Short Direction	Long Direction
Available Moment of Inertia (Inch ⁴)	40,000	24,000
Required Moment of Inertia (Inch ⁴)	9,659	9,872
Required Moment of Inertia controlled by	Width	6*Beta

Shear Stress Analysis - Edge Lift Mode

Maximum Shear, Short Direction	1.27	K/FT
Maximum Shear, Long Direction	1.32	K/FT
	Short Direction	Long Direction
Allowable Shear Stress (PSI)	146	145
Actual Shear Stress (PSI)	11	11

Cracked Section Analysis - Edge Lift Mode

	Short Direction	Long Direction
Cracked Section Capacity (FT-K)	150.6	86.2
0.5 Moment (FT-K)	34.9	22.1

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SUMMARY OF INPUT DATA

Material Properties

Concrete Strength, f'_c :	3,000.0 PSI
Concrete Creep Modulus, E_c :	1,500,000.0 PSI
Concrete Unit Weight :	145.0 PCF
Tendon Strength, F_{pu} :	270.0 KSI
Tendon Diameter :	1 / 2 Inch

Slab Properties

Rectangle Label :	Garage
Rectangle Geometry :	24.00 FT x 40.00 FT x 4.00 Inches
	<u>Short Direction</u> <u>Long Direction</u>
Number of Slab Tendons :	5 3

Beam Properties

	Short Direction		Long Direction		
	Type I	Type II	Type I	Type II	
Quantity :	8	0	5	0	
Depth :	13.5	0.0	13.5	0.0	Inches
Width :	12.0	0.0	12.0	0.0	Inches
Tendons :	0	0	0	0	
Cover :	3.00	0.00	3.00	0.00	Inches

Average beam spacing used in analysis

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SUMMARY OF INPUT DATA - Continued

Soil Properties

Allowable Bearing Pressure :	1,500.0 PSF						
	<table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 50%; text-align: center;"><u>Center Lift</u></th> <th style="width: 50%; text-align: center;"><u>Edge Lift</u></th> </tr> <tr> <td style="text-align: center;">7.00 Feet</td> <td style="text-align: center;">3.00 Feet</td> </tr> <tr> <td style="text-align: center;">1.900 Inches</td> <td style="text-align: center;">0.700 Inches</td> </tr> </table>	<u>Center Lift</u>	<u>Edge Lift</u>	7.00 Feet	3.00 Feet	1.900 Inches	0.700 Inches
<u>Center Lift</u>	<u>Edge Lift</u>						
7.00 Feet	3.00 Feet						
1.900 Inches	0.700 Inches						
Edge Moisture Variation Distance, e_m :							
Differential Soil Movement, y_m :							

Load, Deflection and Subgrade Properties

Slab Loading

Uniform Superimposed Total Load :	40.00 PSF
Total Perimeter Load :	750.00 PLF
Smallest Load Intensity :	250.00 PLF

Stiffness Coefficients

Center Lift :	360
Edge Lift :	720

Prestress Calculation

Subgrade Friction calculated by method prescribed in PTI Manual

Prestress Loss :	15.0 KSI
Subgrade Friction Coefficient :	0.75

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PTI EXCEPTION SUMMARY

**The following elements of the design are not in strict compliance with the
Design of Post-Tensioned Slabs-On-Ground 3rd Edition manual
published by the Post-Tensioning Institute.**

NO PTI EXCEPTIONS EXIST