CRAFT
Engineering
Studio

State Street Garage Installation

State Street Campus Garage
Westport, Wisconsin 53518

CR-26042

CALCULATION REPORT

JULY 17, 2026

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REVISION	DESCRIPTION	ISSUED BY	DATE	CHECKED BY
00	Structural Calculation Report – DD100 Permit	JCM	07/17/2026	CGF

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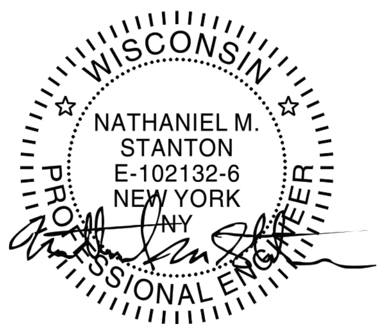

DATE July 17, 2026

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1 INTRODUCTION

The State Street Garage Installation involves the design of the structural elements of an art installation to be located at the above noted address. The installation involves two metal robins supported by a fabricated metal perch as well as a series of three metal eggs to be located on the ground. The robins are fabricated from fully welded thin steel faceted plates, fully welded to a steel pipe tree branch which anchors to the existing parking garage structure.

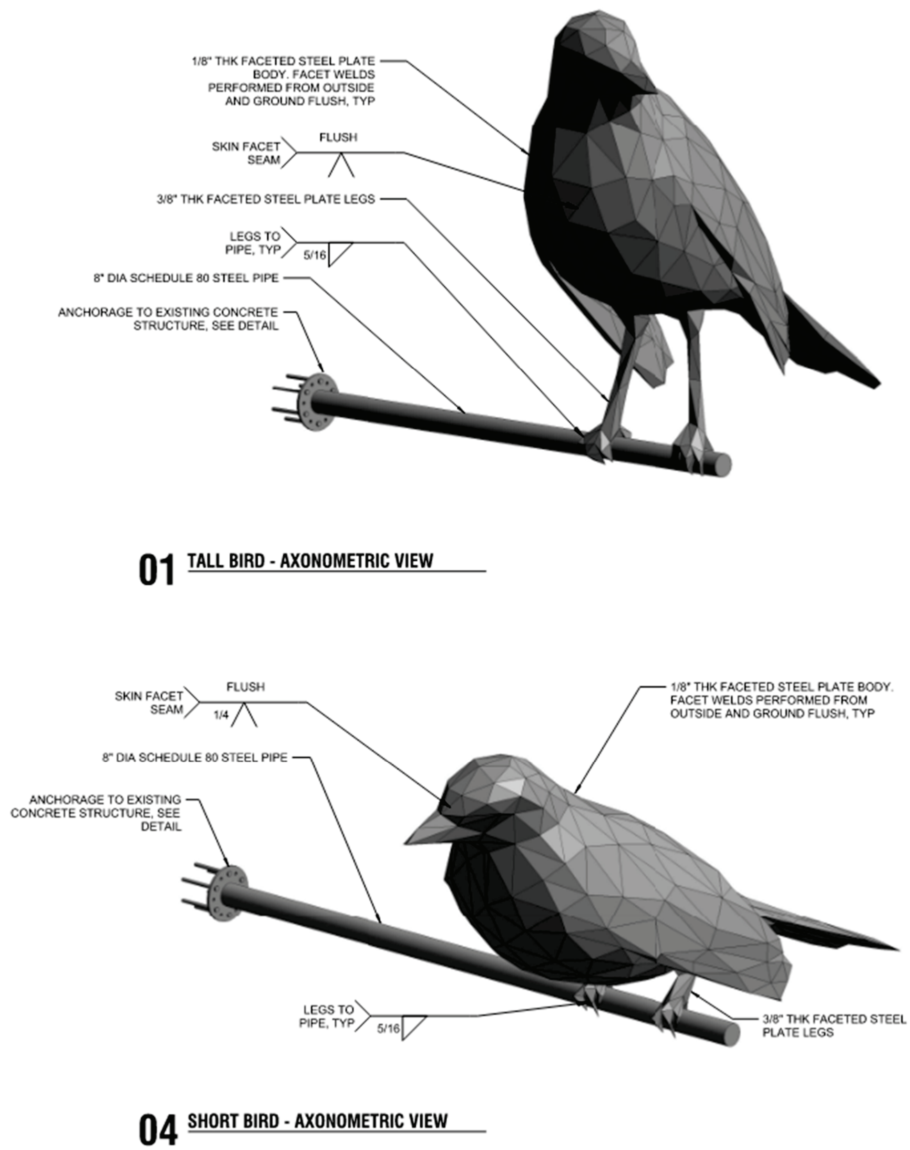


Figure 1-1: Structural Axon Summary of Tall Bird (Top) and Short Bird (Bottom)

2 DESIGN STANDARDS

The structure is designed to meet or exceed the minimum requirements of the following reference standards, as modified by the Building Code:

Local Building Code	2021 Wisconsin State Building Code
IBC Reference	2021 International Building Code (with amendments)

The standards listed below are based on references listed in Chapter 35 of the 2021 International Building Code. Please check Local Jurisdiction Building Code for exclusions or changes.

Steel	AISC: "Steel Construction Manual" Fifteenth Edition, 2017 , by American Institute of Steel Construction AISC “Specification for Structural Joints using ASTM A325 or A490”
Welding	AWS D1.1/D 1.1M-18: "Structural Welding Code - Steel" by American Welding Society
Concrete	ACI 318-19: "Building Code Requirements for Reinforced Concrete" 2019, by the American Concrete Institute
Design Loads	ASCE 7-16 : "Minimum Design Loads for Buildings and Other Structures" 2016, by American Society of Civil Engineers

3 REFERENCE DOCUMENTS

The documents listed below were used as reference for the calculations provided in this document.

Rhino Model	Concept Model by StudioKCA
Structural Drawings	Existing Parking Structure, Dated 10/2/2023, by Pierce Engineers

4 MATERIALS

The materials listed in this section are the preferred materials/grades/sizes for design and analysis purposes. See the Drawings and Specifications for the project requirements for construction.

4.1 Structural Steel

Section	Material Specification	Fy (ksi)	Fu (ksi)	Shape Reference
Steel Pipe	ASTM A53	35	60	AISC Manual
Plates, Bars, Threaded Rods	ASTM A572	50	65	

Steel Properties:	
Density	490 pcf
Young's Modulus	E = 29x10E6 psi
Poisson's Ratio	$\upsilon = 0.30$
Coefficient of thermal expansion	$\alpha = 6.5\text{x}10^{-6}/^{\circ}F$

Shop Paint: All non-galvanized steel shall be shop painted, see Structural Notes and Project Specifications

Galvanizing: All steel exposed to exterior or moisture shall be hot dip galvanized, unless otherwise noted.

4.2 Structural Grout

Specification	Min. Compressive Strength	Notes
Non-Shrink Grout Pre-mix Type	5000 psi	Use Non-staining Grout at exposed Locations

4.3 Fasteners

Fasteners shall be in accordance with the following:

Post-Installed Anchors

Type	Product	Grade	Fy (Fu)	Diameter	Notes
Adhesive	HIT-HY 200 +HAS	ASTM F1554, Grade 55	55 ksi (75 ksi)	1"	Hilti-HY 200 Epoxy Adhesive

4.4 Welding

Material	Grade (fu)	Min. Weld Size	Certification	Notes
Steel (All)	E70xx (70 ksi)	Min. weld size to conform to AISC and AWS criteria	AWS Requirements	

4.5 Concrete

Concrete properties of the existing structure to which the sculpture is connecting are understood to be the following, obtained from the structural drawings:

Location	*f'c (psi)	Density
Columns	8,000	Normal Weight

*f'c = 28-day compressive strength of a cylinder (6"x12") in psi.

5 LOAD CASES

General design criteria for dead and live loads are given in this section.

5.1 Material Self-Weight

Dead load have been calculated using the following assumed densities:

Steel: 490 pcf

5.2 Wind Loads

Wind load data below is in accordance with ASCE 7 Chapter 29: Wind Loads on Building Appurtenances and Other Structures

Risk Category	II	Table 1.5-1, ASCE 7-16
Importance Factor, I	1.0	Table 1.5-2, ASCE 7-16
Exposure Category	D	ASCE 7 Hazard Tool
Basic Wind Speed, V	120 mph	ASCE 7 Hazard Tool
ASD Wind Speed, V_{ASD}	93 mph	
Wind Directionality Factor, Kd	0.85	Table 26.6-1, ASCE 7-16
Velocity Pressure Exposure Coefficient, Kz	1.12	Table 26.10-1, ASCE 7-16
Topographic Factor, Kzt	1.0	Section 26.8, ASCE 7-16
Ground Elevation Factor, Ke	1.0	Section 26.9, ASCE 7-16
Velocity Pressure, qh	32.2 psf	EQ 26.10-1, ASCE 7-16
Gust-Effect Factor, G	0.85	Section 26.11, ASCE 7-16
Force Coefficient, Cf	1.81	Figure 29.3-1 for solid freestanding sign
Design Wind Pressure, p	49 psf	EQ 29.3-1, ASCE 7-16

5.3 Snow Loads

Design Snow Loads have been calculated in accordance with ASCE 7 and the ASCE Hazard Tool.

Ground Snow Load, p_g	30 psf	ASCE Hazard Tool
Importance Factor, I	1.0	Table 1.5-2, ASCE 7-16
Exposure	Fully Exposed	Table 7.3-1, ASCE 7-16
Exposure Factor, Ce	0.9	Table 7.3-1, ASCE 7-16
Thermal Factor, Ct	1.0	Table 7.3-2, ASCE 7-16
Flat roof snow load, p_f	21 psf	$0.7C_eC_tI_sp_g$, Eq 7.3-1, ASCE 7-16

5.4 Seismic Loads

Earthquake load data below is in accordance with ASCE 7 and obtained from the site ASCE Hazard Report

1s Period Mapped Spectral Response Acceleration Parameter, S_1	0.047g	ASCE Hazard Tool
Short Period Mapped Spectral Response Acceleration Parameter, S_s	0.072g	ASCE Hazard Tool
1s Period Site Design Response Acceleration, S_{D1}	0.077g	ASCE Hazard Tool
Short Period Site Design Response Acceleration, S_{DS}	0.084g	ASCE Hazard Tool
Response Modification Factor, R	2	Table 15.4-2, ASCE 7-16, *Amusement Structures and Monuments*
Seismic Design Category	B	ASCE Hazard Tool
Seismic Site Class	D	Assumed - No Geotechnical Report Provided
Importance Factor, I	1.0	Table 1.5-2, ASCE 7-16

6 LOAD COMBINATIONS

Load combinations shall meet the specifications of ASCE-7 2016, Chapter 2.

6.1 Strength or Load and Resistance Factor Design

Reference 2.3 Load Combinations for Strength Design:

1.4D	(2.3.1-1)
1.2D + 1.6L+ 0.5S	(2.3.1-2)
1.2D + 1.6S + 0.5W	(2.3.1-3)
1.2D + 1.0W+ L + 0.5S	(2.3.1-4)
0.9D + 1.0W	(2.3.1-5)
1.2D + Ev + Eh + L + 0.2S	(2.3.6-6)
0.9D – Ev + Eh + L	(2.3.6-7)

6.2 Allowable Stress Design

Reference 2.4 Load Combinations for Allowable Stress Design:

D	(2.4.1-1)
D + L	(2.4.1-2)
D + S	(2.4.1-3)
D + 0.75L + 0.75S	(2.4.1-4)
D + 0.6W	(2.4.1-5)
D + 0.75L + 0.75(0.6W) + 0.75S	(2.4.1-6)
0.6D + 0.6W	(2.4.1-7)
D + 0.7Ev + 0.7Eh	(2.4.1-8)
D + 0.525Ev + 0.525Eh + 0.75L + 0.75S	(2.4.1-9)
0.6D - 0.7Ev + 0.7Eh	(2.4.1-10)

6.3 Seismic Load Effect

Reference 12.4, ASCE-7:

$$E = E_H \pm E_V$$
$$E_H = \rho F_P$$
$$E_V = 0.2 S_{DS} D$$

7 PERFORMANCE CRITERIA

7.1 Drift

Drift Criteria	Allowable Drift
Sculpture Drift under Wind Load	1-1/2” total

7.2 Modal Analysis

Natural Frequency	Horizontal
Sculpture	2 Hz

8 CALCULATIONS

The calculations and results presented below are based on the assumptions and criteria presented in the previous sections. The structural performance of the sculpture is assessed utilizing finite element analysis software. This section presents the analysis results for serviceability performance and design ratios of structural component and members, which represents the worst-case deflections, utilizations, and imposed loads.

8.1 Finite Element Analysis Model Summary

The robin sculptures each consist of solid steel plate skin elements fully welded at the seams. The plates comprising the feet of each robin are fully fixed at their bottom edges, representing the full weld to the steel cantilever pipe support, analyzed independently at this stage of design.

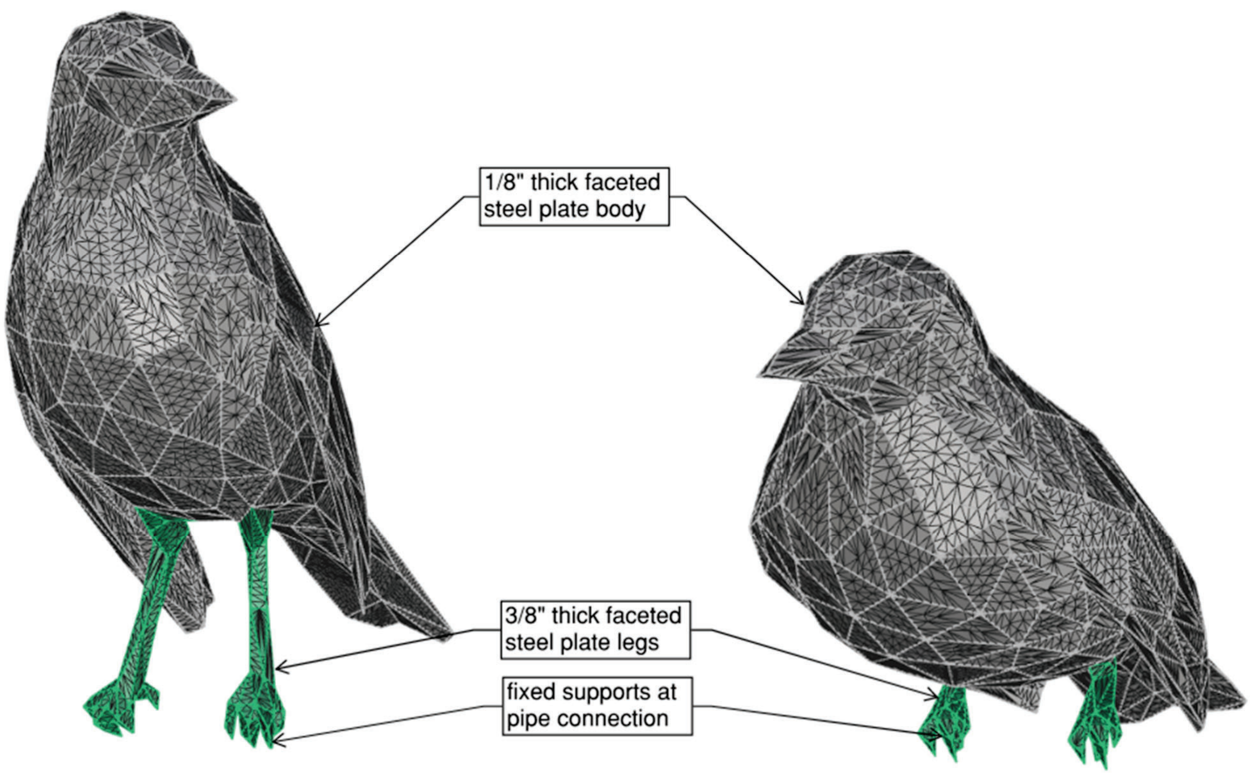


Figure 8-1: FEA Model Summary of Tall Bird (Left) and Short Bird (Right)

8.2 Deflection

The maximum deflections of the two sculptures were limited to less than 1-1/4", occurring at the head of both birds due to global rocking induced by wind load.

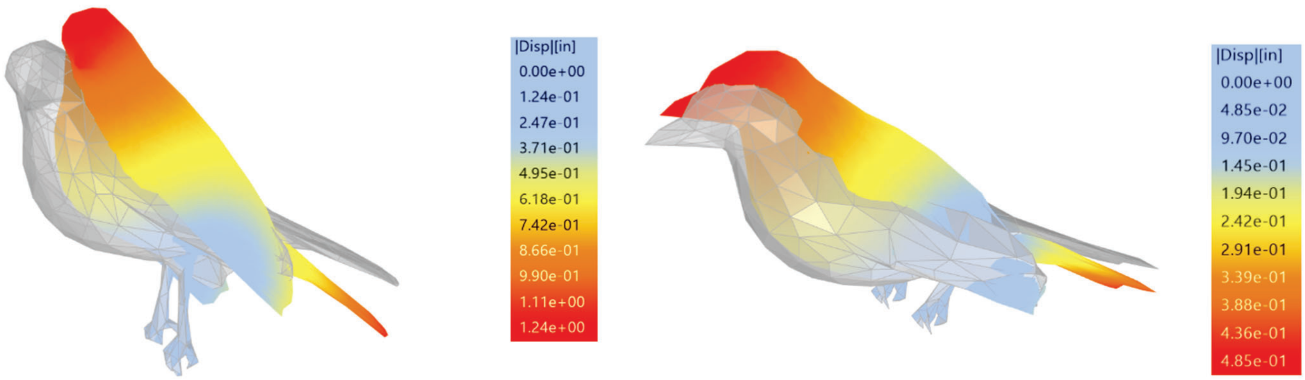


Figure 8-2: Displacement Contours for the Taller Bird (Left) and Shorter Bird (Right)

8.3 Stress

The maximum allowable Von Mises stress for 50ksi steel is limited to 0.6Fy or 30ksi when considering an ASD load level general stress evaluation. The controlling case for stress in the taller bird, D+0.6Wx, yields a maximum stress of 29.4ksi in the legs as they resist moment from backwards rocking due to wind. The controlling case for stress in the shorter bird, D+0.6Wy, yields a maximum stress of 19ksi in the transition from the body to legs as the two legs form a portal frame to resist moment from sideways rocking due to wind.

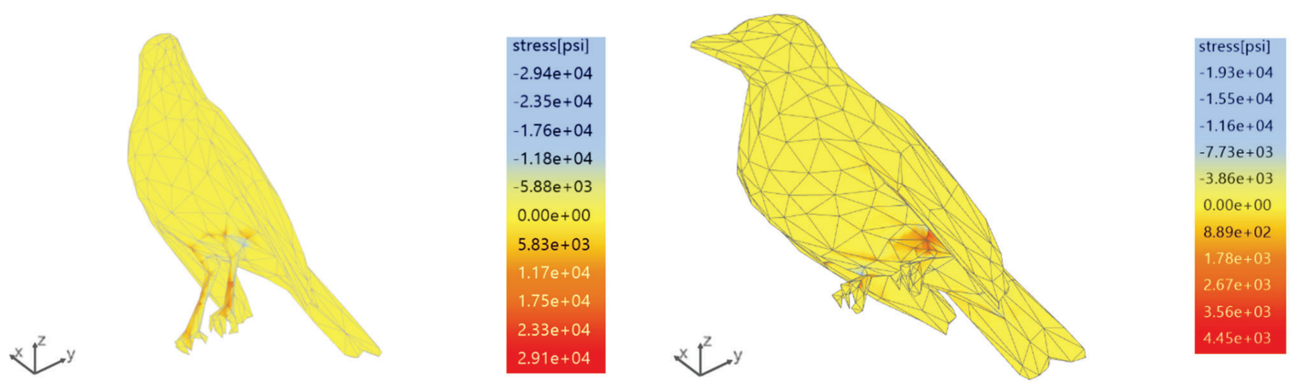


Figure 8-3: Stress Contours for the Taller Bird (Left) and Shorter Bird (Right)

8.4 Natural Frequency

The natural frequency of the structure is evaluated to ensure a minimum value above 2Hz to avoid harmonic resonance from wind gusts. The results of the first mode frequencies are noted below.

Sculpture	First Mode Fundamental Frequency
Tall Robin	4.72 Hz
Short Robin	5.93Hz

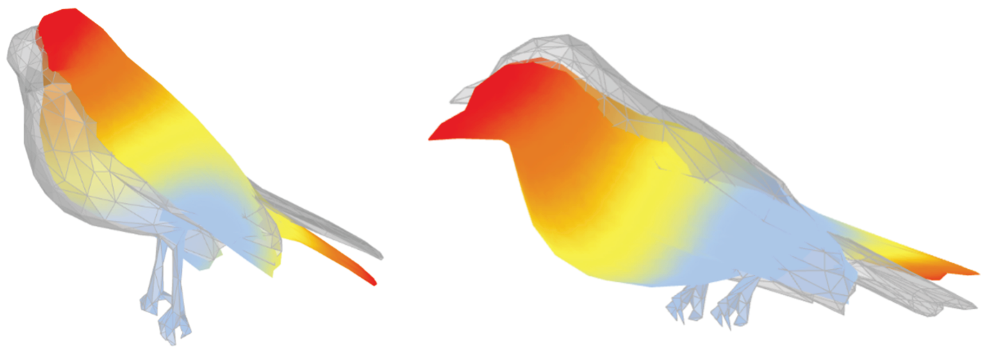


Figure 8-4: First Mode Frequency Displacement Contours. Tall Robin (Left) and Short Robin (Right)

8.5 Metal Cantilever Support Pipe

The metal pipe cantilever support is analyzed at this stage of design as a cantilever beam with the reactions of the bird studies applied as a single point load. Final size of the pipe to be coordinated with building engineer and fabricator in a future phase. The results of the preliminary cantilever study are the following:

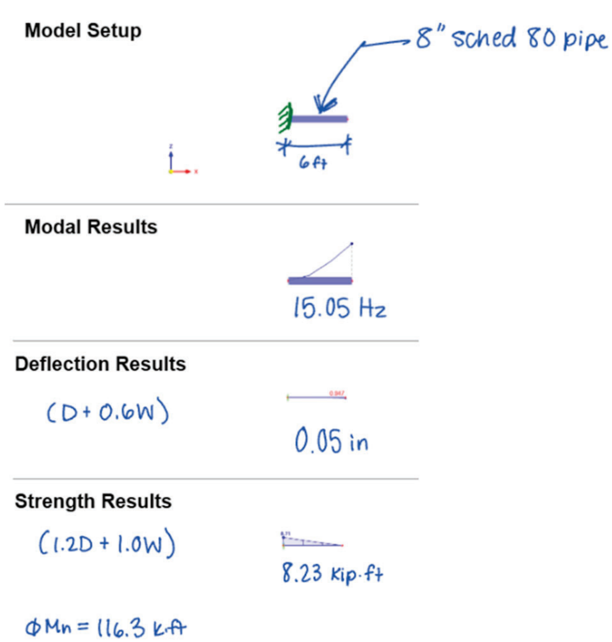
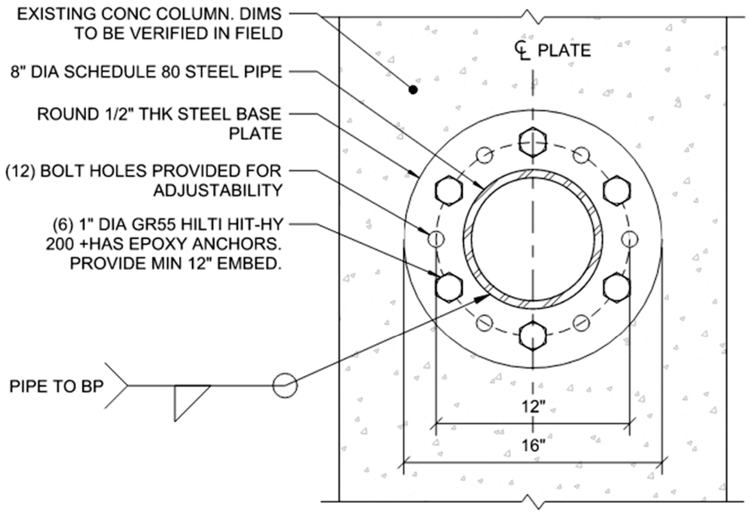


Figure 8-5: Cantilever Pipe Analysis Summary

8.6 Connections

Anchorage calculations to the existing concrete parking structure were performed using the worst-cast reaction loads and are summarized below.



NOTES:

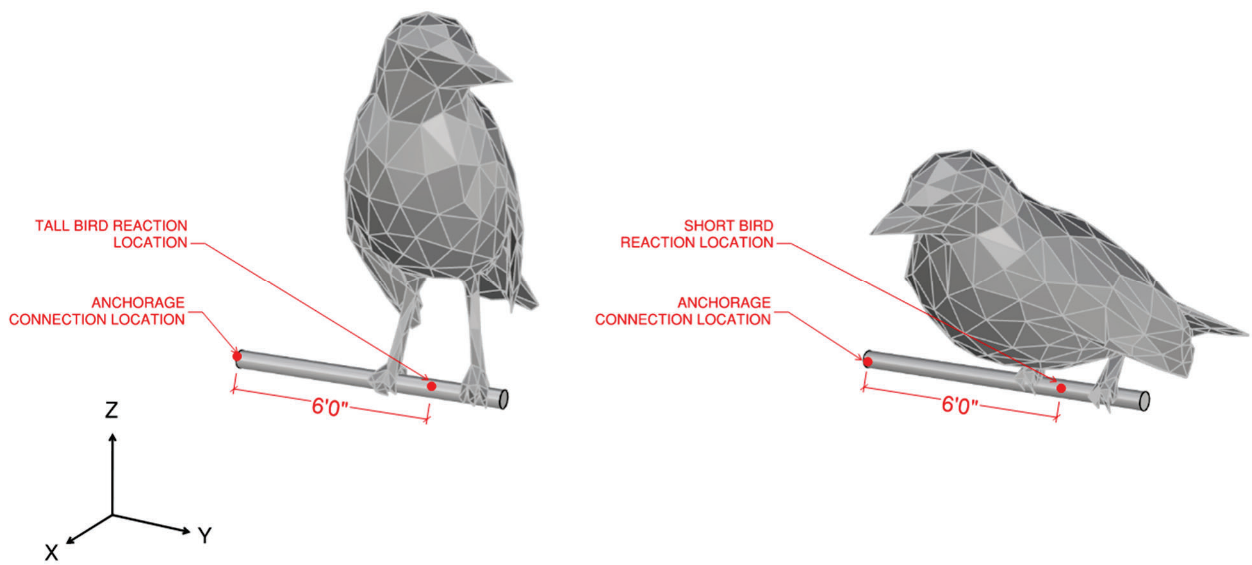
1. CONTRACTOR SHALL SCAN AND AVOID EXISTING REBAR PRIOR TO DRILLING
2. CONTRACTOR TO SEQUENCE INSTALLATION TO PLACE TOP CENTER ANCHOR FIRST. INSTALL REMAINING ANCHORS IN EVERY SECOND HOLE AS SHOWN ABOVE. OTHER BOLT HOLES MAY BE UTILIZED IF NECESSARY TO AVOID EXISTING REBAR

Figure 8-6: End Plate Detail

9 LOADS IMPOSED

The loads imposed used for determining the anchorage requirements consider unfctored dead and wind loads only at the current stage of design and are summarized below.

All reactions are provided as unfactored loads with the exception of the vertical direction, loads may be applied in either direction.



	Fx (lb)			Fy (lb)			Fz (lb)		
	DL	Wx	Wy	DL	Wx	Wy	DL	Wx	Wy
TALL BIRD	0	500	0	0	0	750	1050	0	0
SHORT BIRD	0	600	0	0	0	750	900	0	0

	Mx (lb-ft)			My (lb-ft)			Mz (lb-ft)		
	DL	Wx	Wy	DL	Wx	Wy	DL	Wx	Wy
TALL BIRD	0	0	1800	0	1200	0	0	0	0
SHORT BIRD	0	0	1200	0	900	0	0	0	0

Figure 9-1: Loads Imposed

10 APPENDIX

TBD