

# Alternate Foundation and Structure Designs

## Mississippi Backwater Construction Challenges

Presented by: Simon Murley, PE

May 4th, 2023  
Business Use



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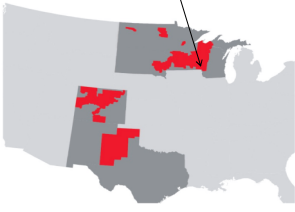
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## Xcel Energy

Project Location



- Serving eight states
- 3.6 million electricity customers
- 2 million natural gas customers

Nationally recognized leader:

- Wind energy
- Energy efficiency
- Carbon emissions reductions
- Innovative technology
- Storm restoration

Business Use

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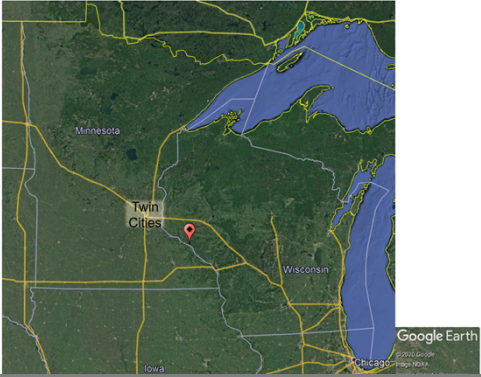
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Project Location: ~70 miles Southeast of Minneapolis, MN

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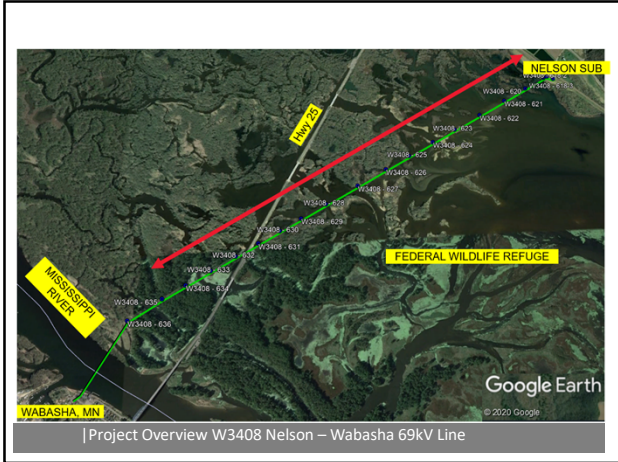
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**Plan of Attack**

1. Structure Design
2. Foundation Design
3. Construction

Business Use

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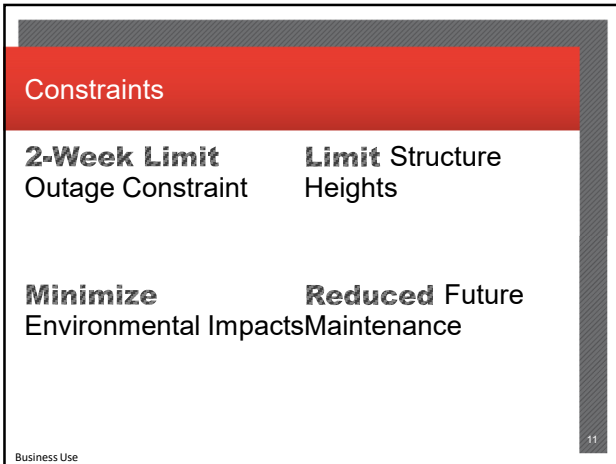
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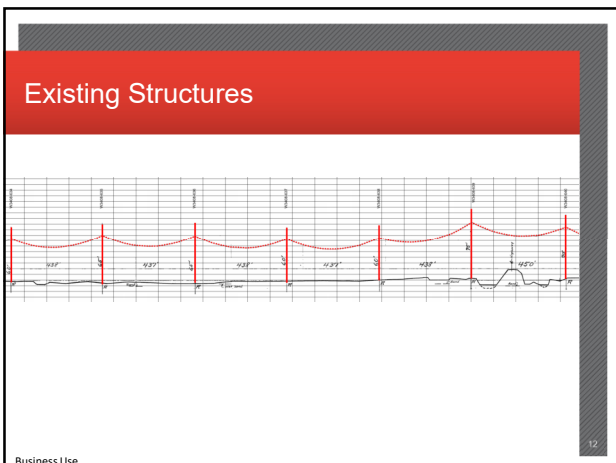
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### Typical Design

- 477 kcmil 26/7 ACSR Hawk
- Avg. Str. Ht. = 63± ft.
- 25 Tangent Structures
- RS = 450 ft.

Business Use

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### Long-Span Design Proposal

- 477 kcmil 26/7 ACSS/TW/HS285 Hawk
- Avg. Str. Ht. = 68± ft.
- 15 Tangent Structures (10 fewer)
- RS = 730 ft.

Business Use

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### Structure Design

- Steel H-Frame
- Galvanized Finish
- 11,000 to 15,000 lb weight (tangents)
- Saddle & pin crossarm
- Over-sized baseplate holes

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Business Use

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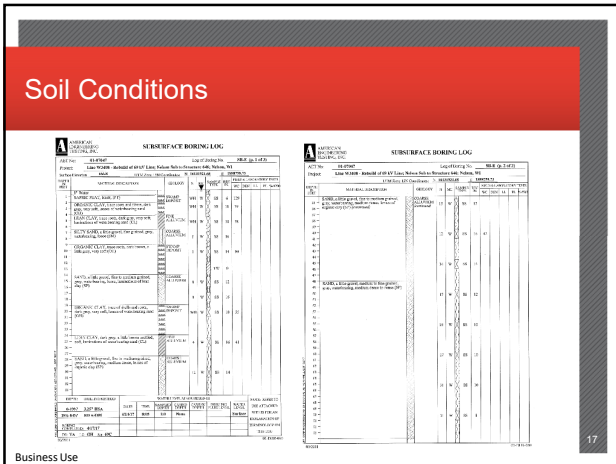
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Business Use

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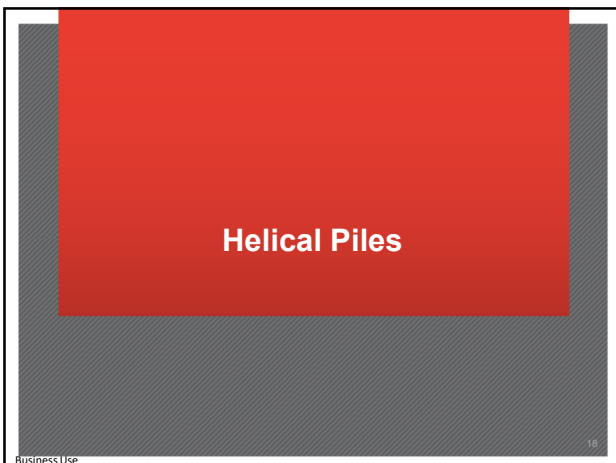
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Business Use

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### Helical Piles

**NOTES:**

- FINISH: GALVANIZE PER ASTM A153 (LATEST REVISION)
- MATERIALS:
  - BASE PLATE: PLATE STEEL PER ASTM A572 GR50, 1-1/2" THICK.
  - BEAM WASHERS: PLATE STEEL PER ASTM A572 GR50, 1" THICK.
  - CAP PLATES: PLATE STEEL PER ASTM A572 GR50, 3/8" THICK.
  - CLAMPS: PLATE STEEL PER ASTM A572 GR50, 1-1/2" THICK.
  - THREADED: 1/2" X 3/8" IN THREADED ROD PER AISI 4130 HOT ROLLED STEEL.
  - CENTER TUBE: 12 X 12 X 5/8 PER ASTM A572 GR50
  - PILE TUBE: 10 X 10 X 3/8 PER ASTM A572 GR50

— SQUARE TUBE FILLED WITH NONDENSIFYING GREASE HIGHER 4000 PSI COMPRESSIVE STRENGTH PROVIDED BY OTHERS

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4 PILE GRILLAGE

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### RS3500, 300 HELICAL PIERS

TENSILE STRENGTH RATING: 33,000 PSI-LR  
ULTIMATE TENSILE STRENGTH: 33,000-51 KIP  
YIELD STRENGTH: 24,000 PSI-LR  
MINIMUM ELONGATION: 20%  
MINIMUM ELONGATION: 20%  
MINIMUM ELONGATION: 20%

CH. NO.	"A"	"B"	"C"	"D"	"E"	"F"
0000000000	10"	10"	10"	10"	10"	10"
0000000001	12"	12"	12"	12"	12"	12"
0000000002	14"	14"	14"	14"	14"	14"
0000000003	16"	16"	16"	16"	16"	16"
0000000004	18"	18"	18"	18"	18"	18"
0000000005	20"	20"	20"	20"	20"	20"
0000000006	22"	22"	22"	22"	22"	22"
0000000007	24"	24"	24"	24"	24"	24"
0000000008	26"	26"	26"	26"	26"	26"
0000000009	28"	28"	28"	28"	28"	28"
0000000010	30"	30"	30"	30"	30"	30"

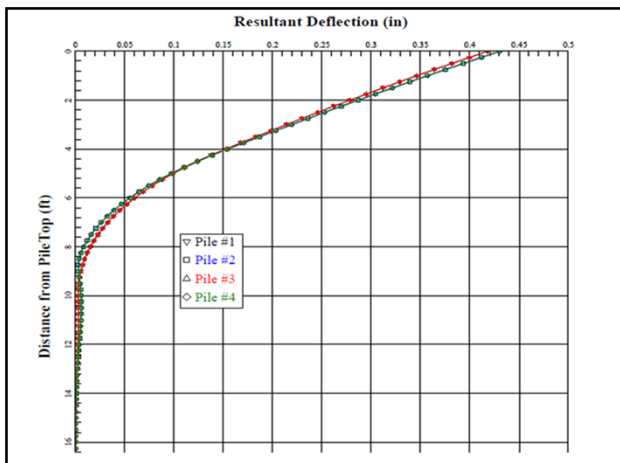
CH. NO.	"A"	"B"	"E"
0000000000	10"	10"	10"
0000000001	12"	12"	12"
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0000000003	16"	16"	16"
0000000004	18"	18"	18"
0000000005	20"	20"	20"
0000000006	22"	22"	22"
0000000007	24"	24"	24"
0000000008	26"	26"	26"
0000000009	28"	28"	28"
0000000010	30"	30"	30"

**NOTES:**

- HOT DIP GALVANIZED PER ASTM A153-LATEST REV.
- LEAD AND EXTENSION SECTION LENGTHS AND HELIX SPACINGS ARE NOMINAL.
- NOMINAL SPACING BETWEEN HELIX PLATES IS THREE TIMES THE DIAMETER OF THE LEAD HELIX.
- SHAFT MATERIAL PER ASTM A572 OR A500 GRADE B OR MECHANICAL EQUIVALENT.
- HELIX MATERIAL: LHM CARBON STEEL, MEETING THE GENERAL REQUIREMENTS OF A511, OR ASTM A572, A575, A576, OR A518.
- CLAMPING BOLTS: 1/2" DIA. CLASS 8.18, 2-3/4" LONG HEX HEAD PER SAE J489 GRADE 5.
- MANUFACTURER SHALL HAVE IN EFFECT INDUSTRY RECOGNIZED WRITTEN QUALITY CONTROL.
- FOR ALL MATERIALS AND MANUFACTURING PROCESSES.
- ALL WELDING TO BE DONE BY WELDERS CERTIFIED UNDER SECTION 9 OF THE AWS CODE D1.
- EXTENSIONS INCLUDE A COLD UPSET INTEGRAL COUPLING ON ONE END.

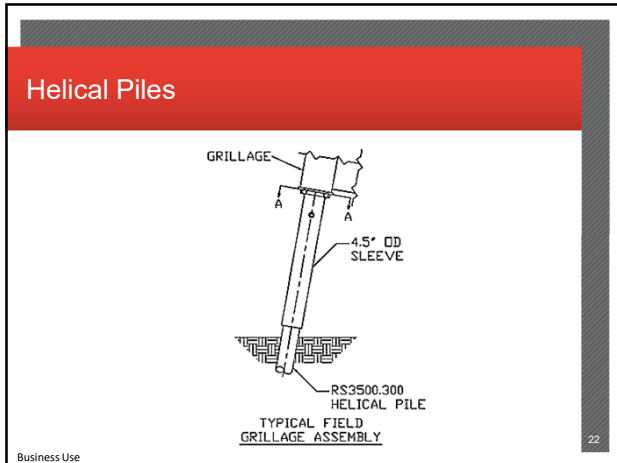
**CHANCE** HUBBELL POWER SYSTEMS, INC.  
RS3500, 300 LEADS AND EXTENSIONS

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**Helical Piles**

- Evaluated using HeliCAP V2 ® software
- $Q_{ult} = 40.6$  kip
- Helical configuration:  
» 10-12-14-14 inches

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**Helical Piles**

- $T = 5,800$  ft\*lbs
- Standard empirical torque / capacity ( $K_t$ ) factor for the RS3500.300 piles is 7 to 1:

$$Q_{ult} = K_t * T$$

Where:

- $Q_{ult}$  = Ultimate capacity (40.6 kip)
- $K_t$  = Empirical torque factor (7 ft<sup>-1</sup>)
- $T$  = Average installation torque

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## Corrosion Protection

Levels	DESCRIPITON
1	1/8-inch sacrificial loss of steel on all external surfaces.
2	All components to be hot-dip galvanized per the requirements of ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
3	External spray coating: Bottom coat of 5 to 7 mil coating of Sherwin Williams Phenicon HS Flake-filled and top coat of 3 to 5 mils of polyurethane Acrolon 218, High Solids Poly, Corothane I.

Business Use 25

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## Vibratory Caissons

Business Use 26

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## Axial Capacity

- General equation:

$$Q_{all} = f_s * A_s$$

Where:

- $Q_{all}$  = Allowable capacity in compression
- $f_s$  = Allowable skin friction
- $A_s$  = Area of outside caisson shaft

Business Use 27

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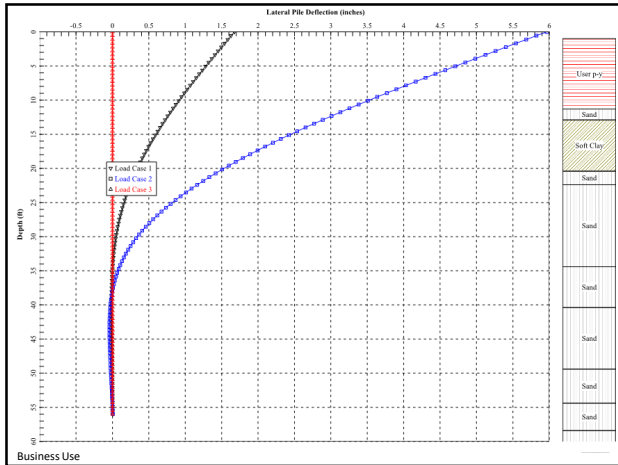
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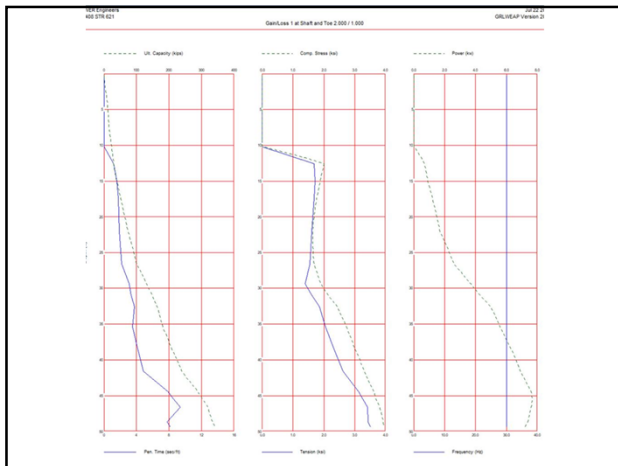
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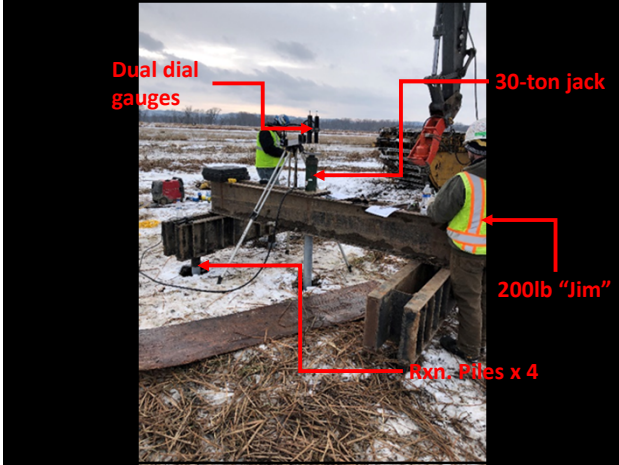
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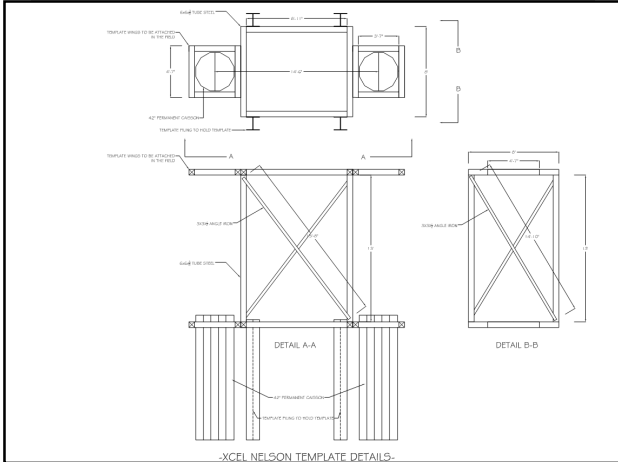
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Business Use

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- ### Acknowledgements
- Project team:
- Xcel Energy  
<https://www.xcelenergy.com/>
  - POWER Engineers, Inc  
<http://www.powereng.com/>
  - Chance Civil Foundation Systems  
<https://www.hubbell.com/chancefoundationsolutions/en/>
  - Atlas Foundation Company  
<https://www.atlasfoundation.com/>
  - JF Brennan Construction  
<https://www.jfbrennan.com/>
  - Erickson Air-Crane  
<https://ericksoninc.com/>
  - Braun Intertec  
<https://braunintertec.com/>
- Business Use 44

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