Alternate Foundation and Structure Designs

Mississippi Backwater Construction Challenges

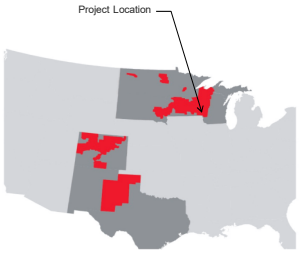
Presented by: Simon Murley, PE

May 4th, 2023

Business Use

1

Xcel Energy

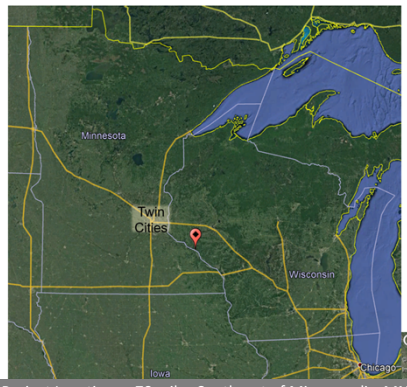


Serving eight states
- 3.6 million electricity customers
- 2 million natural gas customers

Nationally recognized leader:
- Wind energy
- Energy efficiency
- Carbon emissions reductions
- Innovative technology
- Storm restoration

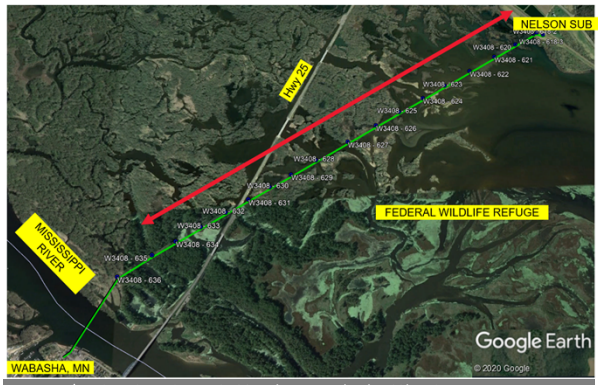
Business Use

2



|Project Location: ~70 miles Southeast of Minneapolis, MN

3



|Project Overview W3408 Nelson – Wabasha 69kV Line

4

5

6

7

8

Plan of Attack

1. Structure Design
2. Foundation Design
3. Construction

9

Structure Design

Business Use

10

Constraints

2-Week Limit Outage Constraint

Limit Structure Heights

Minimize Environmental Impacts

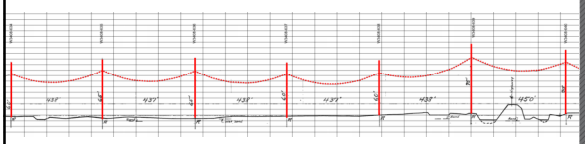
Reduced Future Maintenance

11

Business Use

11

Existing Structures

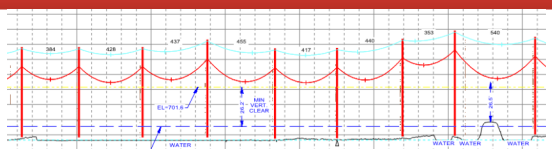


12

Business Use

12

Typical Design



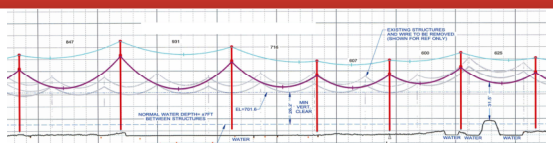
- 477 kcmil 26/7 ACSR Hawk
- Avg. Str. Ht. = 63± ft.
- 25 Tangent Structures
- RS = 450 ft.

Business Use

13

13

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

14

14

Structure Design

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

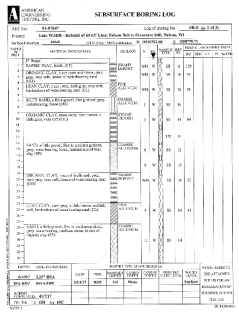
15

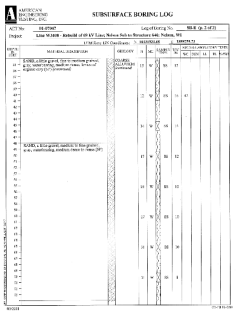
Foundation Design

Business Use

16

Soil Conditions


SUBSURFACE BORING LOG


SUBSURFACE BORING LOG

17

Business Use

17

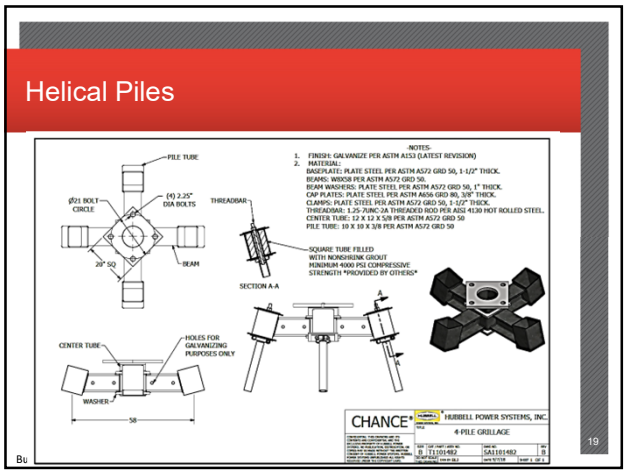
Helical Piles

18

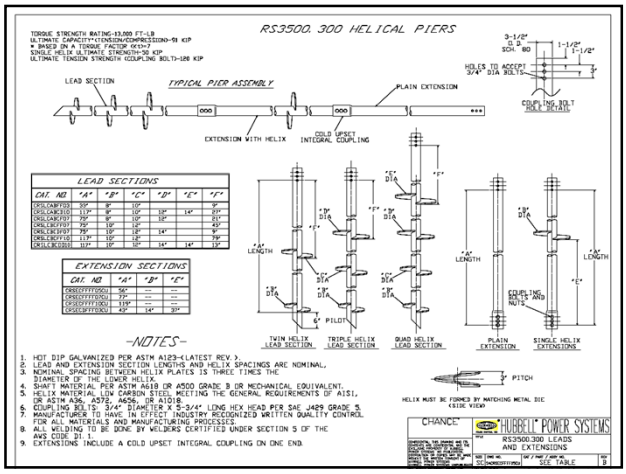
Business Use

18

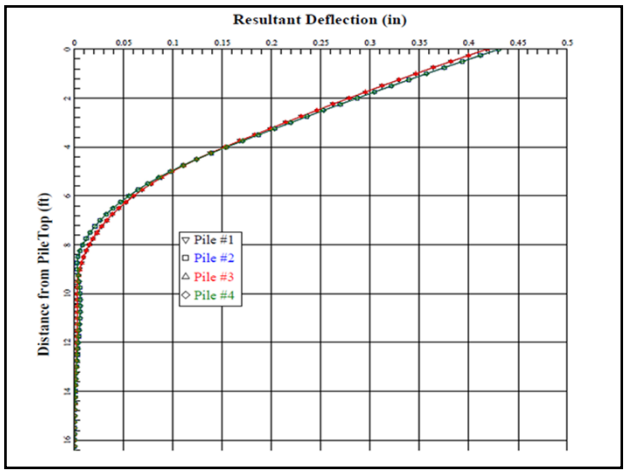
Helical Piles



19

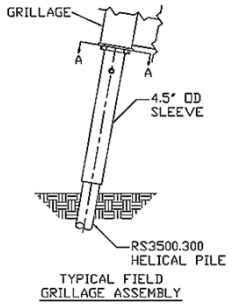


20



21

Helical Piles



TYPICAL FIELD
GRILLAGE ASSEMBLY

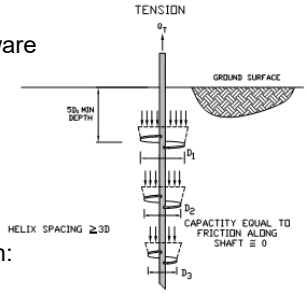
Business Use

22

22

Helical Piles

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



Business Use

23

23

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)
Kt	= Empirical torque factor (7 ft^{-1})
T	= Average installation torque

Business Use

24

24

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.

25

Business Use

25

Vibratory Caissons

26

Business Use

26

Axial Capacity

- General equation:

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

Where:

Q_{all} = Allowable capacity in compression

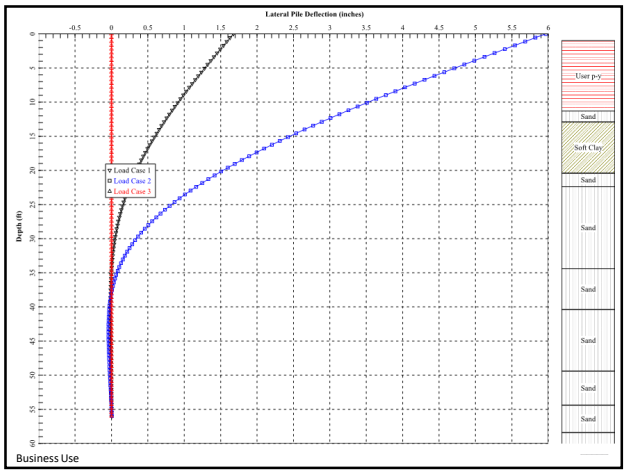
f_s = Allowable skin friction

A_s = Area of outside caisson shaft

27

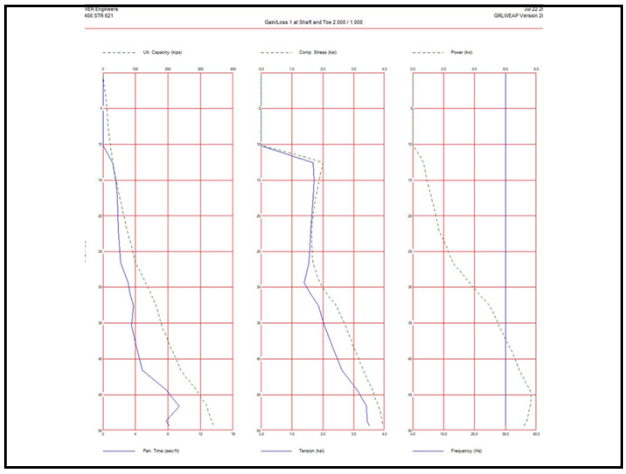
Business Use

27

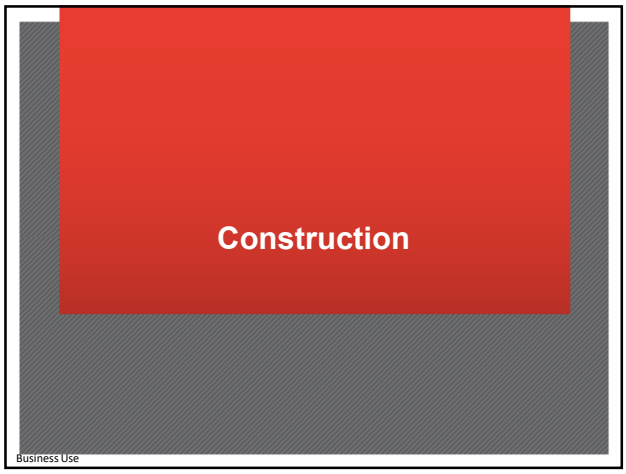


Business Use

28

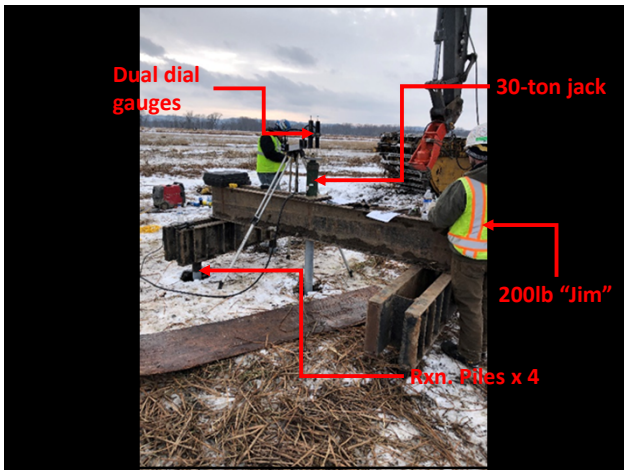


29



Business Use

30


Dual dial gauges
30-ton jack
200lb "Jim"
Rxn. Piles x 4

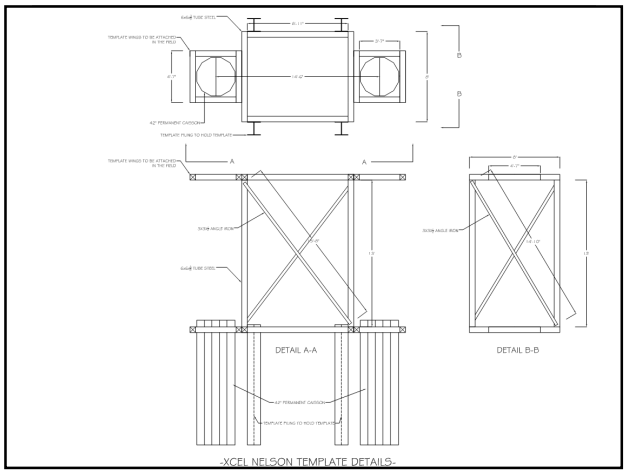
31


Helical Pile Installation
Business Use

32


Completed Helical Piles
Business Use

33



34

35

Business Use

36

37

38

39

40

41

42

Key Take-Aways

3-Step Solution → **Accomplish** **3** Goals

Limit	2-Week	Reduced
Environmental Impacts	Outage Constraint	Future Maintenance

Business Use

43

43

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

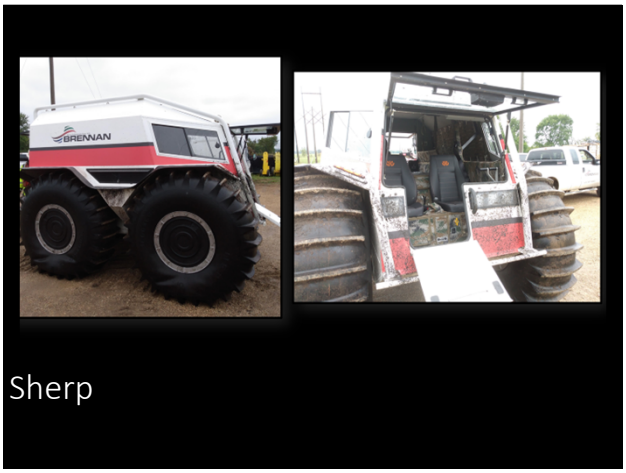
44

44

Marsh Buggy

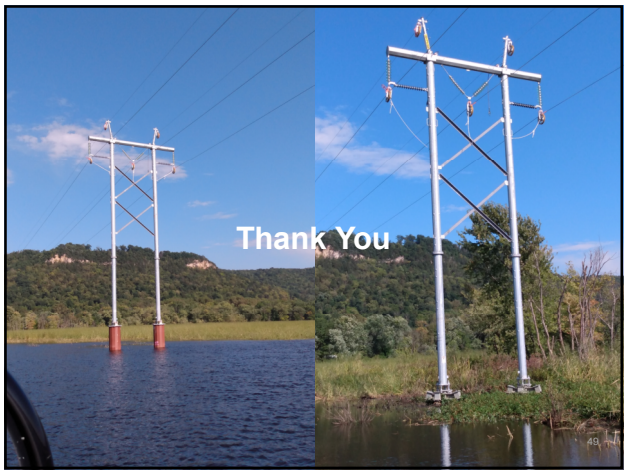
45

46



47

48



49