NUCOR SKYLINE

Jim Hancock
Business Development

About Nucor Skyline

- Premier **innovator** and provider of steel foundation **solutions** in North America, Mexico, Central America, Caribbean, Colombia
- Multi-product; Multi-project focus

Key Company Highlights

NUCOR SKYLINE

- Over 20 Sales Offices
- Robust Infrastructure Comprised of:
  - Manufacturing
  - Coating
  - Fabrication
- Dozens of Stocking Locations
- Exclusive Engineering and Drafting Support

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Nucor Skyline…

Supplies hundreds of thousands of tons of steel foundation products yearly

Our Sales Offices

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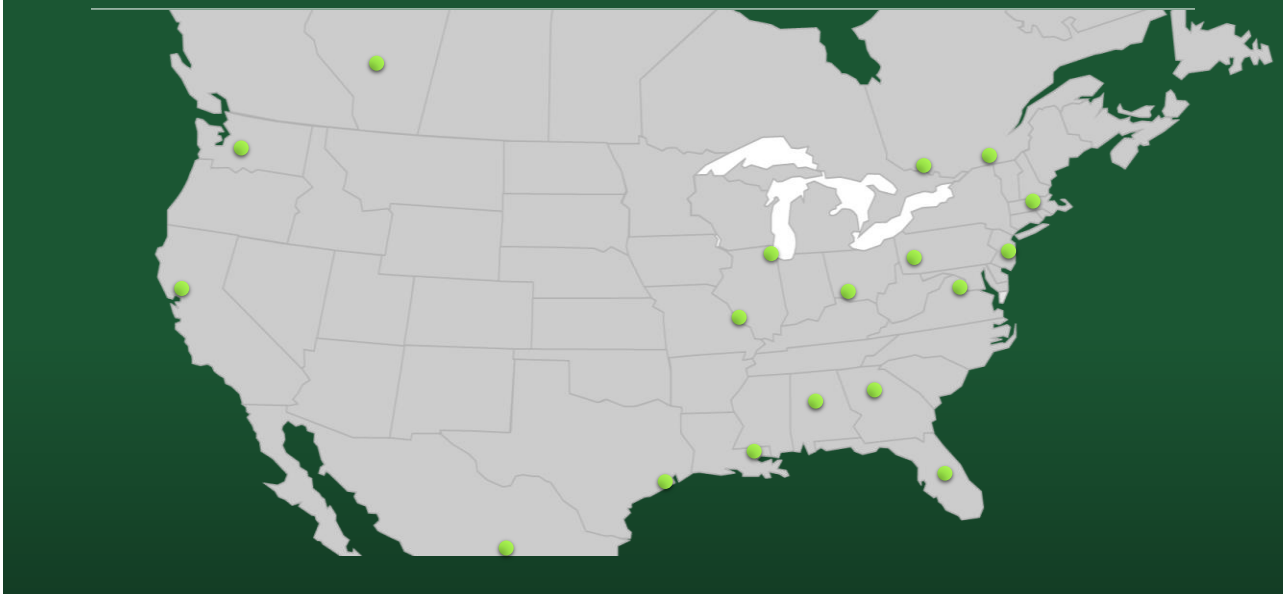

Our Manufacturing Facilities

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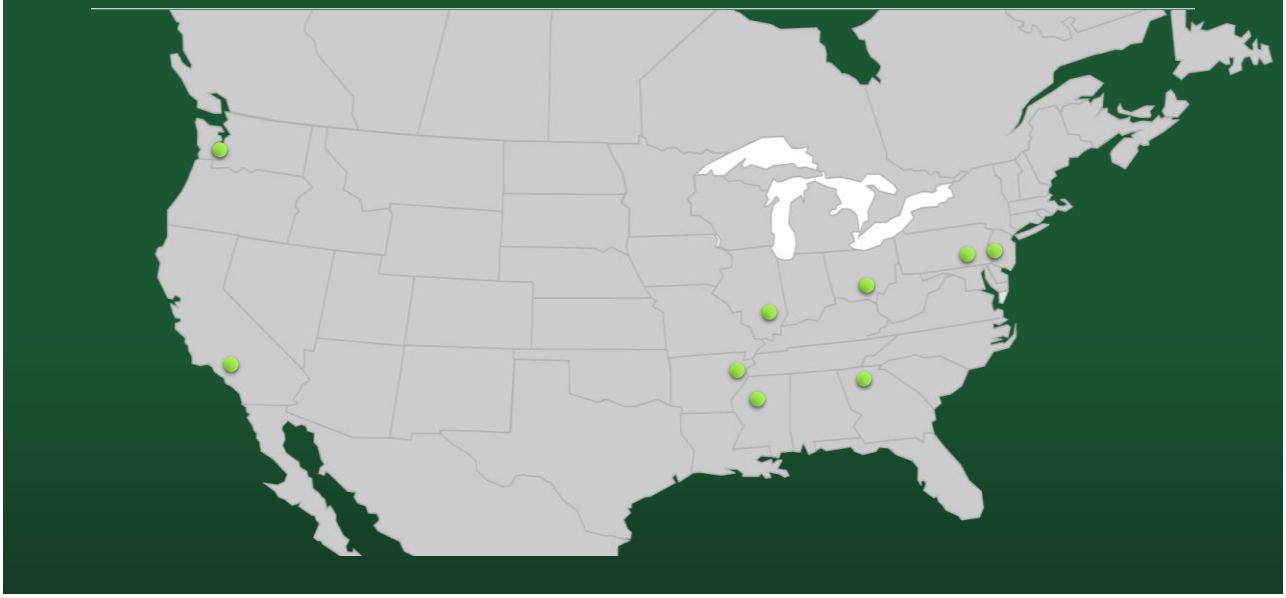

Our Products

NUCOR SKYLINE

- Steel Sheet Pile
- Combined Wall System
- Steel H-pile
- Pipe
- Pile Accessories
- Threaded Bar & Accessories
- Micropiles
- Multi-Strand Anchor Systems
- Hollow Bar & Accessories
- Wide Flange & other Structural Sections

Markets & Applications

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- Marine & Waterfront
- Basement & Underground Parking
- Water & Sewer
- Energy
- Transportation
- Temporary Shoring
- Environmental
- Storm Protection
- Levees, Locks & Dams
- General Building
- Mining

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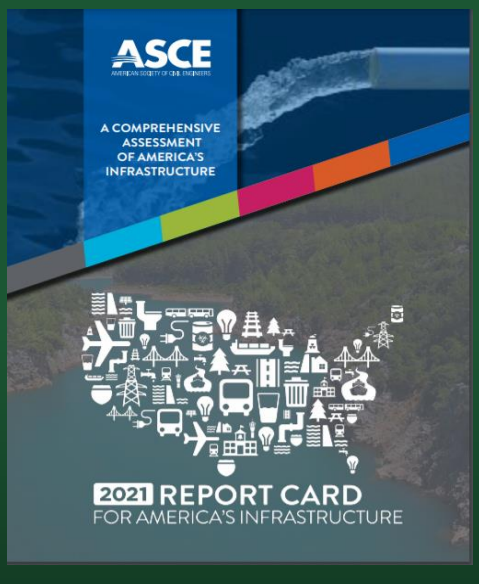
Steel Sheet Pile Bridge Abutment Manual

A Brief Introduction

2021 Infrastructure Report Card

NUCOR SKYLINE

- 2021 Overall Rating: C-
- 2021 Bridge Rating: C
- Structurally Deficient Bridges
  - 46,000
- Bridges More than 50 Years Old:
  - 42%



Introducing….

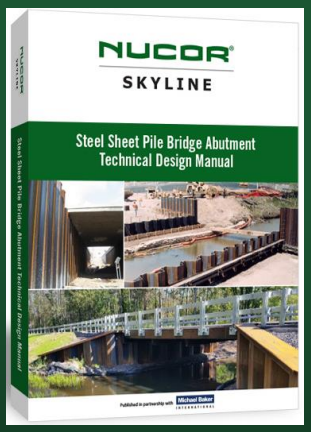
NUCOR SKYLINE

Nucor Skyline's

Steel Sheet Pile Bridge Abutment Technical Design Manual

Currently available in print only

Request your copy at
nucorskyline.com/abutment



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Get the
Steel Sheet Pile Bridge Abutment Technical Design Manual

13

What is a steel sheet pile abutment?

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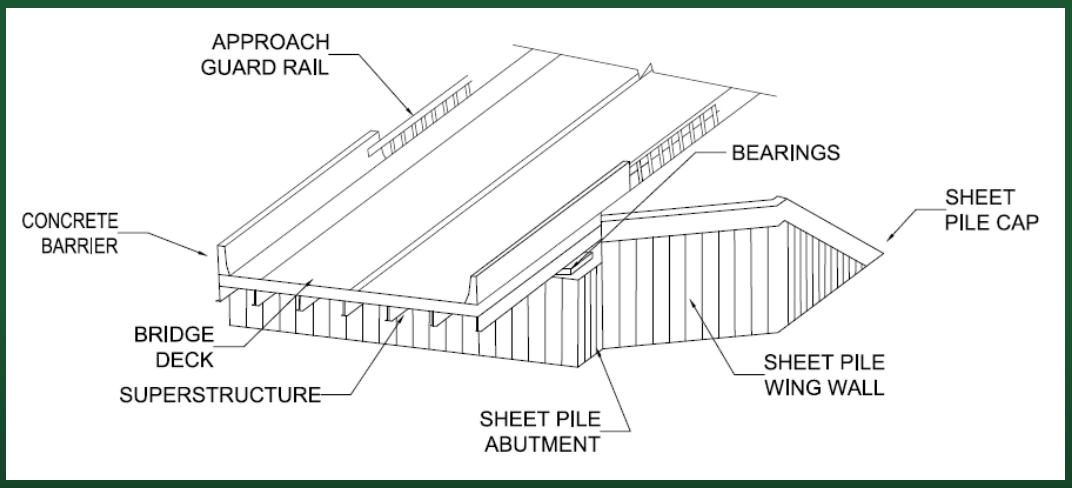

Chapter 1, 2, & 3

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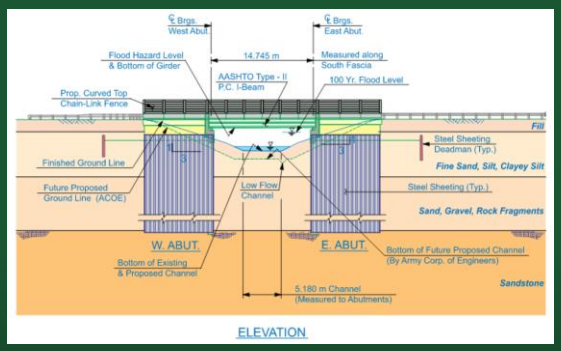
- Chapter 1: Introduction
  - Brief introduction to the conception
  - High level overview of the advantages
- Chapter 2: Background & History
  - Past use in the US and abroad
  - Reference to past research
  - State of the practice
- Chapter 3: General Theory



Sheet Pile Innovations: Bridge Abutments

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- Reduced Material Cost
- Reduce Construction Time
  - No temporary sheets
  - No dewatering required
  - Little or no excavation
- Less Environmental Impact
- Scour protection
- Can be designed to resist lateral, vertical, and seismic loading conditions

Use in the United States

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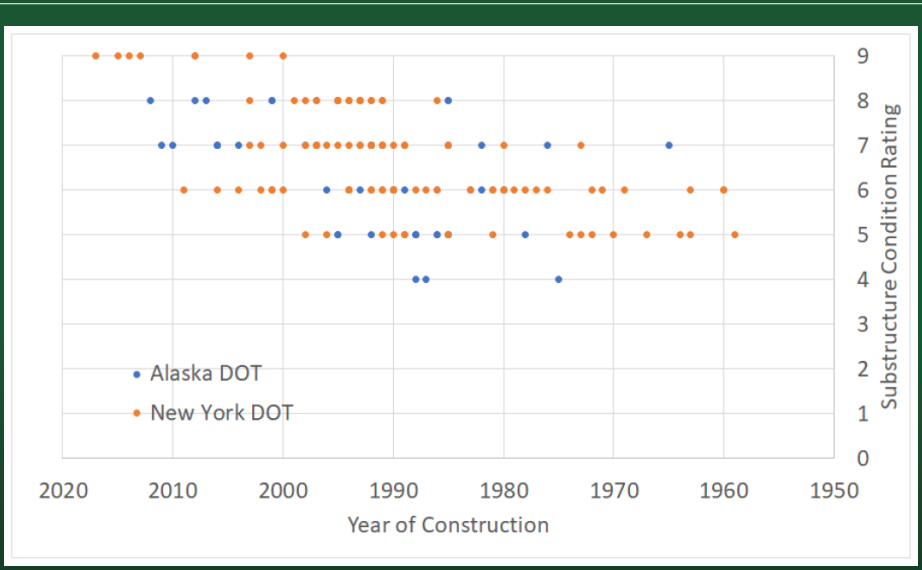

Use in Europe

Germany

Poland

Italy

Poland

Chapter 4: Materials & Properties

- Sheet pile products
  - Hot rolled vs cold formed sheet pile
  - Combined walls – for bridge abutments with high loads
  - Box piles – another option for abutments with high loads
- Tie backs and anchoring systems
- Geotechnical considerations
  - Soil properties
  - Site investigation

Sheet Pile Basics

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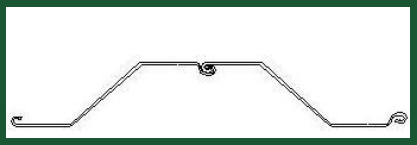
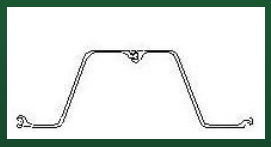
- Hot rolled and cold formed
- Steel Grades:
  - ASTM A572 Gr 50/55/60+
  - ASTM A690
  - ASTM A588



SKZ/SCZ
Domestic Cold-Formed

AZ
Imported Hot-Rolled

NZ
Domestic Hot-Rolled



PZ
Domestic Hot-Rolled

Interlock Styles

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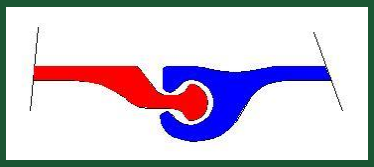
Larssen Interlock
(AZ & NZ)
5° Rotation



Ball and Socket
(PZ)
10° Rotation

Hook and Grip
(SCZ & SKZ)
10° Rotation

Chapter 5: Loads & Analysis

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- General Principles
- Limit State Design
  - Service Limit State
  - Strength Limit State
- Loading
- Analysis Methods
  - Limit Equilibrium Analysis
  - Soil-Structure Interaction
- Pile Cap Analysis
- Strut and Tie Analysis of Pile Cap
- Knife Edge Support Analysis of Pile Cap
- Sheet Pile Drivability

Chapter 6: Resistance

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- Resistance Factors
- Concrete Pile Cap Structural Resistance
- Steel Sheet Pile Structural Resistance
- Sheet Pile Geotechnical Resistance
- Anchorage Resistance
- Extreme Events

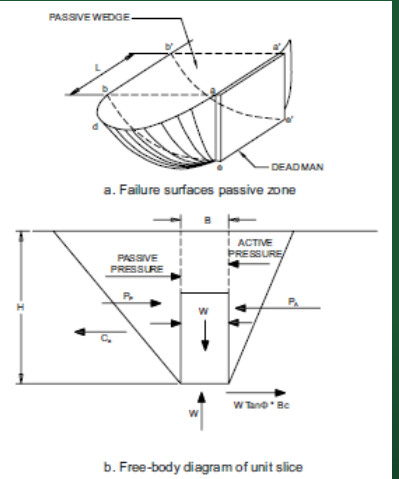

Figure 49: Free Body Diagram of Deadman

Chapter 7: Corrosion

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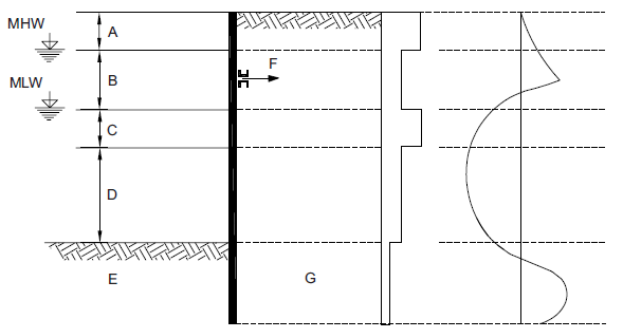
- Sources of Corrosion
- Typical Corrosion Rates of Steel
- Corrosion Mitigation
- Corrosion Testing



a) Vertical zoning of sea water aggressivity

b) Corrosion rate distribution at side exposed to sea water

c) Typical bending moment distribution

A	Zone of high attack (splash zone);	B	Intertidal zone;
C	Zone of high attack (Low water zone);	D	Permanent Immersion zone;
E	Buried zone (Water side);	F	Anchor;
G	Buried zone (Soil side)		
MHW	Mean high water;	MLW	Mean lowwater;

Eurocode Corrosion Rates

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Table 4-1: Recommended value for the loss of thickness [mm] due to corrosion for piles and sheet piles in soils, with or without groundwater

Required design working life	5 years	25 years	50 years	75 years	100 years
Undisturbed natural soils (sand, silt, clay, schist, ...)	0,00	0,30	0,60	0,90	1,20
Polluted natural soils and industrial sites	0,15	0,75	1,50	2,25	3,00
Aggressive natural soils (swamp, marsh, peat, ...)	0,20	1,00	1,75	2,50	3,25
Non-compacted and non-aggressive fills (clay, schist, sand, silt, ...)	0,18	0,70	1,20	1,70	2,20
Non-compacted and aggressive fills (ashes, slag, ...)	0,50	2,00	3,25	4,50	5,75

Notes:

1) Corrosion rates in compacted fills are lower than those in non-compacted ones. In compacted fills the figures in the table should be divided by two.

2) The values given for 5 and 25 years are based on measurements, whereas the other values are extrapolated.

Table 4-2: Recommended value for the loss of thickness [mm] due to corrosion for piles and sheet piles in fresh water or in sea water

Required design working life	5 years	25 years	50 years	75 years	100 years
Common fresh water (river, ship canal, ...) in the zone of high attack (water line)	0,15	0,55	0,90	1,15	1,40
Very polluted fresh water (sewage, industrial effluent, ...) in the zone of high attack (water line)	0,30	1,30	2,30	3,30	4,30
Sea water in temperate climate in the zone of high attack (low water and splash zones)	0,55	1,90	3,75	5,60	7,50
Sea water in temperate climate in the zone of permanent immersion or in the intertidal zone	0,25	0,90	1,75	2,60	3,50

Notes:

1) The highest corrosion rate is usually found in the splash zone or at the low water level in tidal waters. However, in most cases, the highest bending stresses occur in the permanent immersion zone, see Figure 4-1.

2) The values given for 5 and 25 years are based on measurements, whereas the other values are extrapolated.

Methods for Combatting Corrosion

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- Marine Grade Steel
  - A690
  - Added copper and phosphorus allow for “substantially greater resistance to seawater”
- Coatings
- Higher Steel Grade
  - Higher allowable bending moment
- Sacrificial Steel

Chapter 8: Installation

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- Installation Methods
- Driving Methods
- Sheet Pile Installation Tolerances

Chapter 9: Inspection & Maintenance

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- Inspection of the materials and cap beams
- Maintenance of coatings, small corrosion spots, general housekeeping
- Replacement of the super structure
- Deterioration of the concrete cap
- Sustainability of steel

Chapter 10: Aesthetics

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Chapter 11 & 12: Design Examples

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- Chapter 11/Example 1: Compact Sheet Pile Abutment in Point Bearing
  - Simply supported, single span
  - Sheet piles driven to rock
  - Compact sheet piles are used
- Chapter 12/Example 2: Slender Sheet Pile Abutment Using Skin Friction
  - Same as Example 1 except that a slender sheet pile section is used
  - Sheet pile resistance comes from skin friction rather than end bearing

Chapter 13 & 14: References

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Nucor Skyline Sheet Piling Flange Slenderness Ratios
Domestic Hot Rolled Sheet Pile Series

Sheet Pile Series	Shape	b_f (in)	Full Thickness Flanges		Considering 1/16 in Loss from Each Face (-1/8 in total)	
			t_f (in)	$\lambda = b_f / t_f$	$t_{f,reduced}$ (in)	$\lambda = b_f / t_f$
NZ	NZ 14	14.485	0.375	38.63	0.250	57.94
	NZ 19	14.180	0.375	37.81	0.250	56.72
	NZ 20	14.178	0.394	35.98	0.269	52.71
	NZ 21	14.180	0.433	32.75	0.308	46.04
	NZ 26	16.100	0.500	32.20	0.375	42.93
	NZ 28	16.100	0.560	28.75	0.435	37.01
	NZ 38	17.440	0.689	25.31	0.564	30.92
	NZ40	17.7621	0.735	24.17	0.61	29.12
	NZ42	17.7099	0.769	23.03	0.644	27.50

Errata

To view any edits to the manual, click the QR code on the back to visit our website!

Thank you!

NucorSkyline.com/abutment

CASE STUDY
Sprout Brook Bridge

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Sprout Brook Bridge

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- Bridge Information
  - 48 foot span
  - 13 lanes, 209 feet wide
- Original Design
  - Called for temporary sheets to be driven
  - 860 H-Piles to be driven to rock
  - Six lane changes

Value Engineered Redesign

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- Sheets driven to rock
- Less environmental impact
- Saved 10 weeks in construction time
- 700 tons of steel from Skyline Steel
  - $280,000 less in material cost
  - Piles reduced

Existing Bridge

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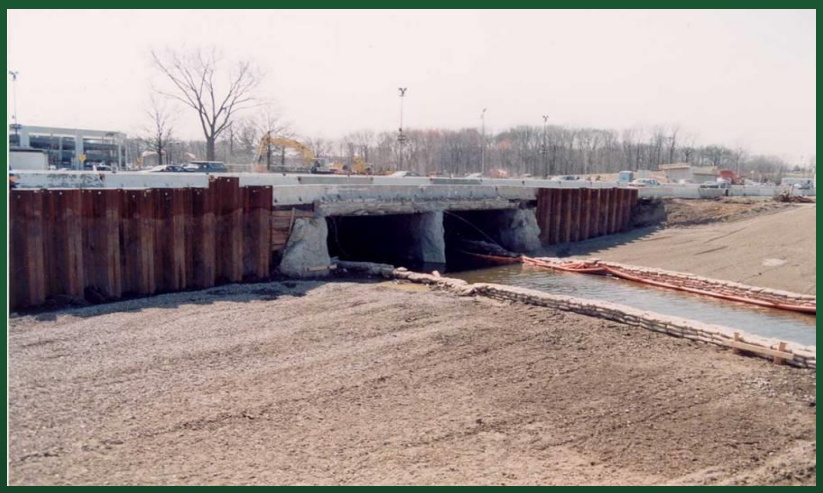

Value-Engineered Design

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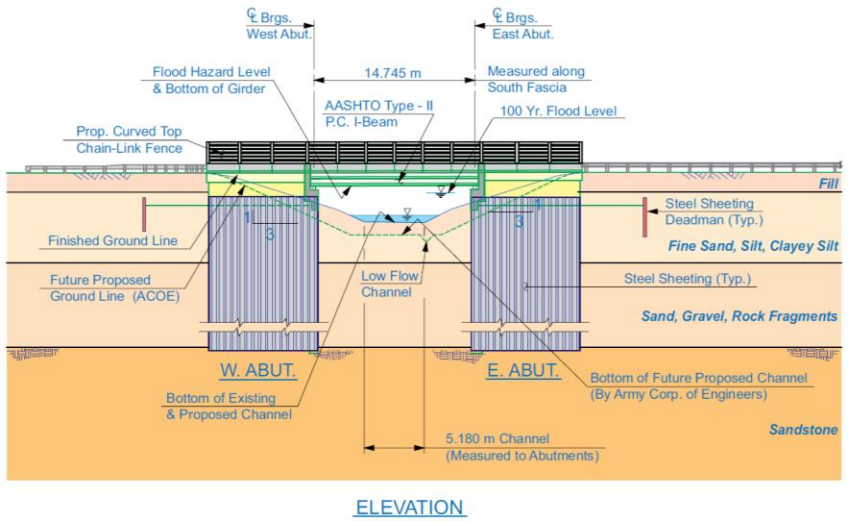

Abutment & Deadman Cross-Section

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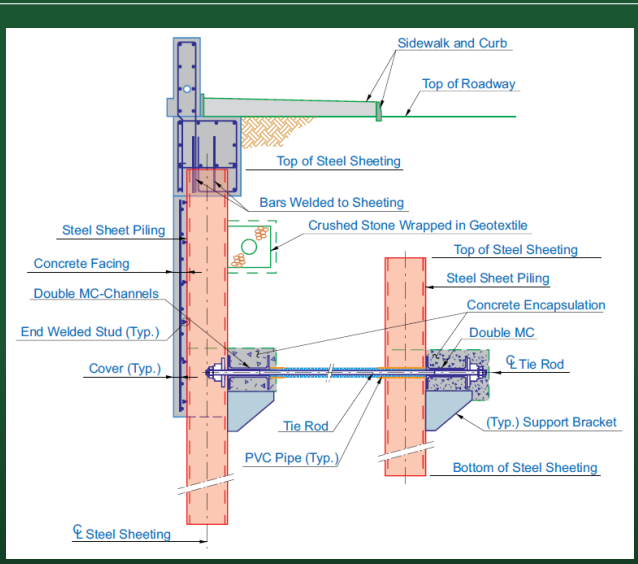

Permanent Sheet Piles

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Deadman Sheet Pile Wall

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Wing Wall Cross-Section

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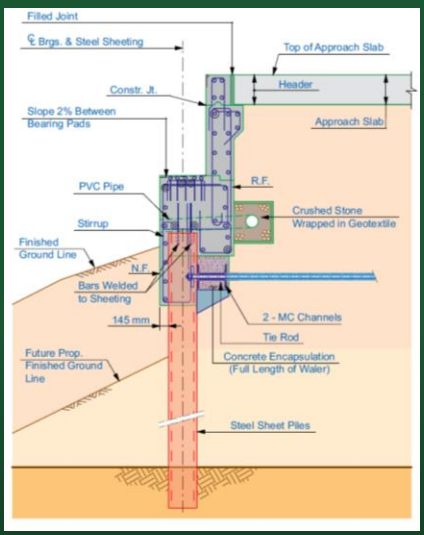

Concrete Cap

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Vertically Loaded Sheet Piles

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Completed Construction

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ILDOT Coles County 1

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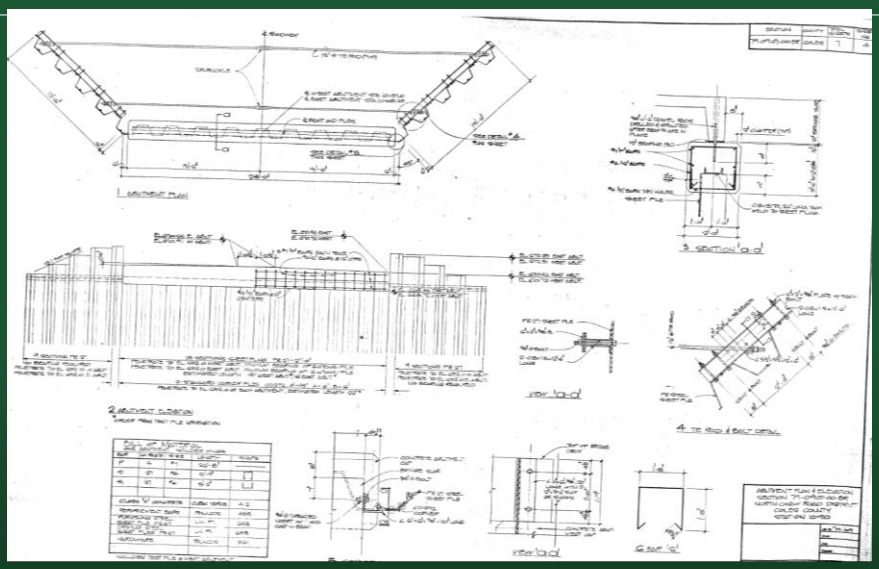

ILDOT Coles County 1

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- Original Abutment
  - Concrete abutments with channel protection and H-piles
  - Low bid in April 2008 = **$433,985**
  - 2 Lanes Wide, 42’-0” bridge span
- Value Engineering
  - Steel Sheet Pile abutments with H-pile behind the sheets for bearing
  - Low bid in August 2008 = **$289,785**
  - Nothing else changed in design

33%

ILDOT Coles County 1

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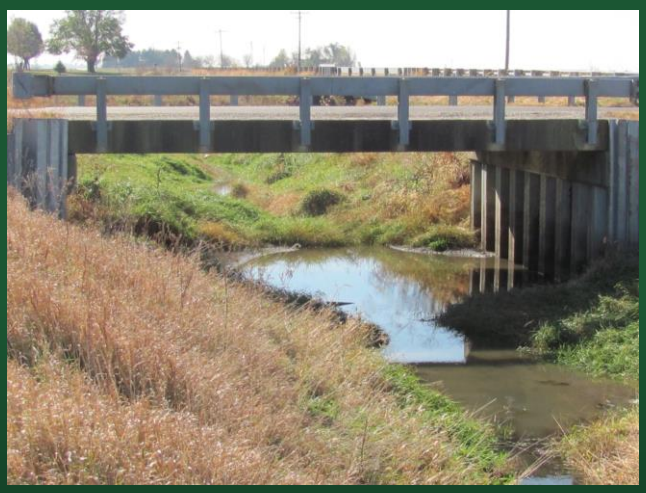

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ILDOT Coles County 1

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Engineering Expertise

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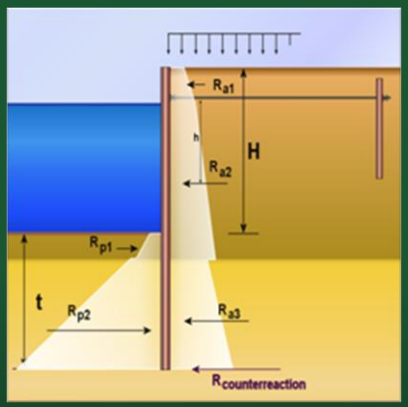
- Complete Analysis and Calculations
- Drawings and Estimating
- Feasibility and Cost Assessments
- Field Engineering Expertise
- Innovative Construction Techniques
- Installation Guidance
- Specification Writing
- Training Programs for PDH Credits



Customized Support

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- **Engineering Staff:**
  Geotechnical, Structural, Environmental, and CAD Draftsman
- **Professional Guidance:**
  Design, Drawings, Delivery, and Installation
- Access to global project information

Website Resources

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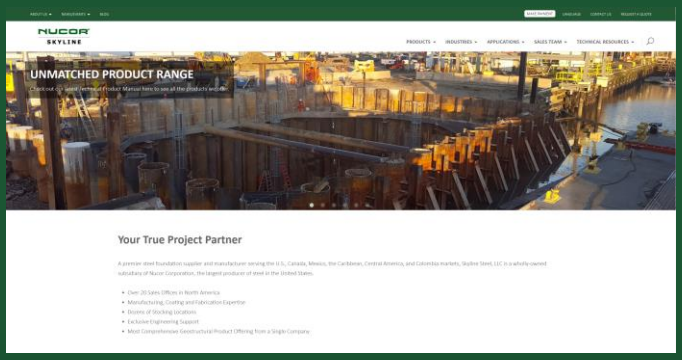

Technical Manuals
Product Manuals
Applications
Data Sheets

Whitepapers
Webinars
Engineering Support
AutoCAD Blocks

Case Studies
Software
Contact Information
New iPhone APP!

Questions

NUCOR SKYLINE

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