

“A bridge is to a road what a diamond is to a ring.”
-Elmer Marx, P.E., S.E.

Twenty Mile Bridge

(Project E)



Terry Gryting, EIT – Project Manager, Hydraulic/Hydrologic Project Engineer

Kelinda Larson, EIT – Structural/Bridge Team Lead

Steven Lemmel – Transportation Team Lead

Gabriel Pierce – Geotechnical Team Lead

April 21, 2017

CE A438 Senior Design



UAA College of Engineering
UNIVERSITY of ALASKA ANCHORAGE

Steven Lemmel – Transportation Team Lead



- 2-year Alaska resident
- Building Crafts Inc. – Water & Wastewater Contractor
- Worked as a carpenter for several years
- Member of ITE Alaska Section
- Enjoys woodworking, soccer, cooking, and road trips

Kelinda Larson – Structural Team Lead



- Lifelong Alaskan
- University of Oregon
 - BS in Mathematics
- Member of the Society of Women Engineers
 - UAA Student Chapter Secretary
- Enjoys hiking, rock climbing, and traveling

Gabriel Pierce – Geotechnical Team Lead



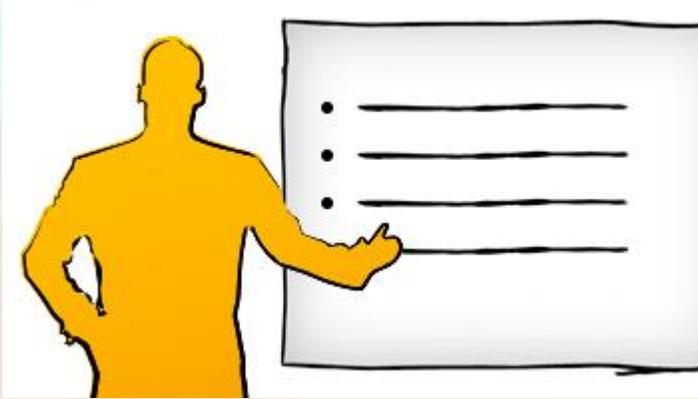
- Lifelong Alaskan
- UAA
 - Environmental Health and Safety
 - Transportation Research Assistant
 - Soils Lab Teaching Assistant
- Enjoys renovating, recycling, and repurposing
- Pursuing an MSCE degree with a focus on geotechnical engineering

Terry Gryting – Project Manager and Hydrologic & Hydraulic Project Engineer



- 21-year Alaska resident
- R&M Consultants – Water Resources Group
- Anchorage Water & Wastewater Utility
- Alaska Energy Authority
- Cabin-building experience
- UAA – Society of Women Engineers (SWE), Engineers Without Borders (EWB), American Society of Civil Engineers (ASCE)
- Enjoys cross-country skiing, a capella music, astronomy, family time at cabin

Outline



- Project Location & Background
- Project Goals
- Summarize Research
- Discussion of Alternatives
- Preferred Alternative
- Engineer's Estimate
- Lessons Learned

Project Location & Background

- Client: Alaska Dept. of Transportation & Public Facilities
- MP 80 of Seward Highway
- Constructed in 1967
- Previous bridge destroyed in the 1964 earthquake



Problem Definition

- Structurally deficient bridge
- Exposed rebar
- Pier walls cracked
- Decking in poor condition
- Diminished load rating



Bridge No.	0634	Br. Name	Twenty Mile River	Date	06/16/15
Tab No.	1	Inspector	Imbsen / Manning	Frame	35
Bottom Flange Rust, Typical					



Bridge No.	0634	Br. Name	Twenty Mile River	Date	06/16/15
Tab No.	1	Inspector	Imbsen / Manning	Frame	
Pier 5 Joint Material Failed					

Problem Definition

(Continued)

- Competing uses of corridor result in safety concerns
- Highest in summertime due to fishing
- Major injury and fatality crashes



Project Goals



The five main goals for this project:

1. Design a replacement bridge
2. Realign the existing roadway
3. Improve safety during periods of high recreational use
4. Minimize environmental impacts
5. Develop a realistic cost estimate

Research

Geotechnical

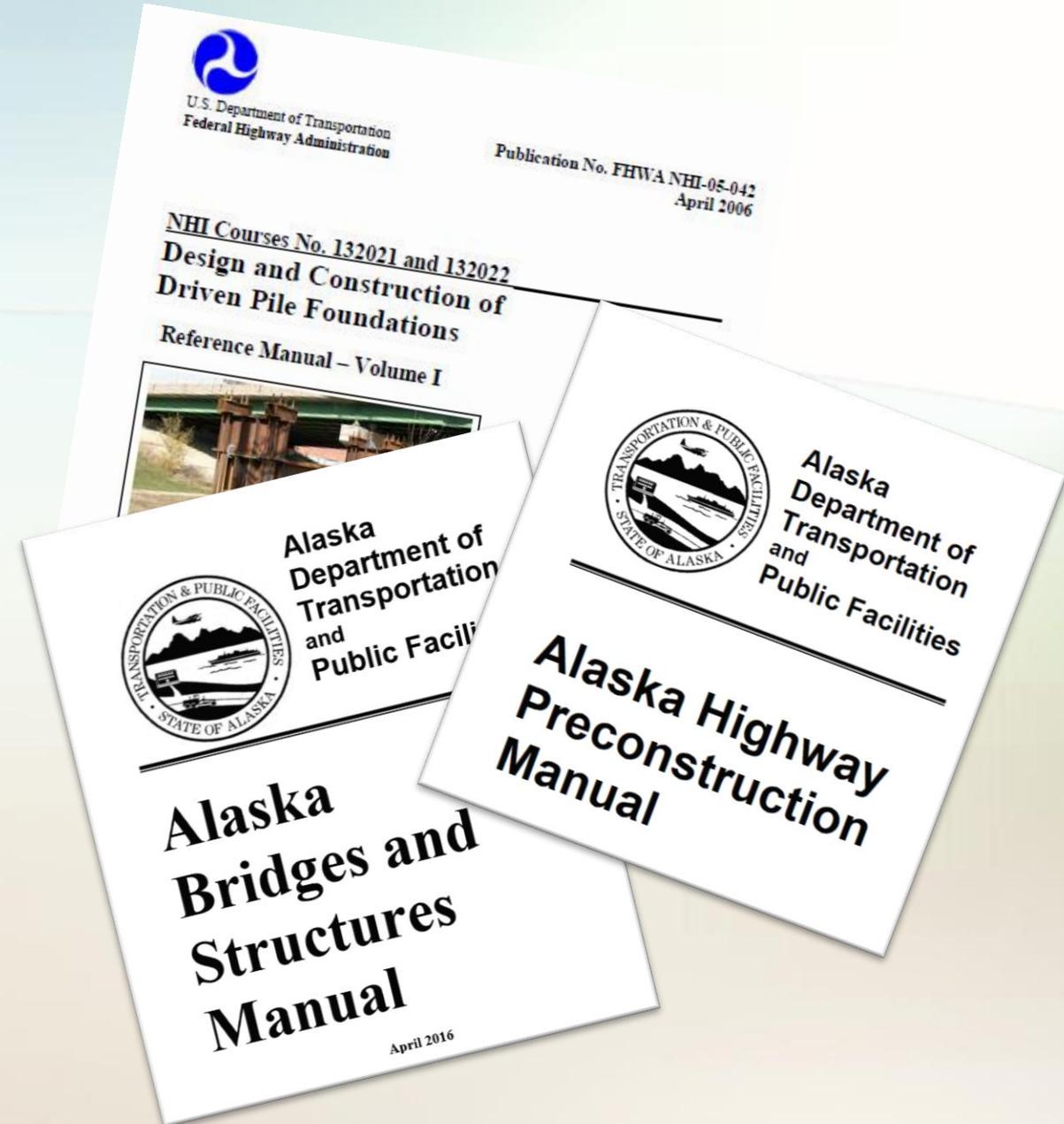
- Design and Construction of Driven Pile Foundations
- Alaska Geotechnical Procedures Manual

Structural/Bridge

- Alaska Bridges and Structures Manual (Draft)
- Elmer Marx, P.E., S.E., DOT&PF Senior Bridge Design Engineer

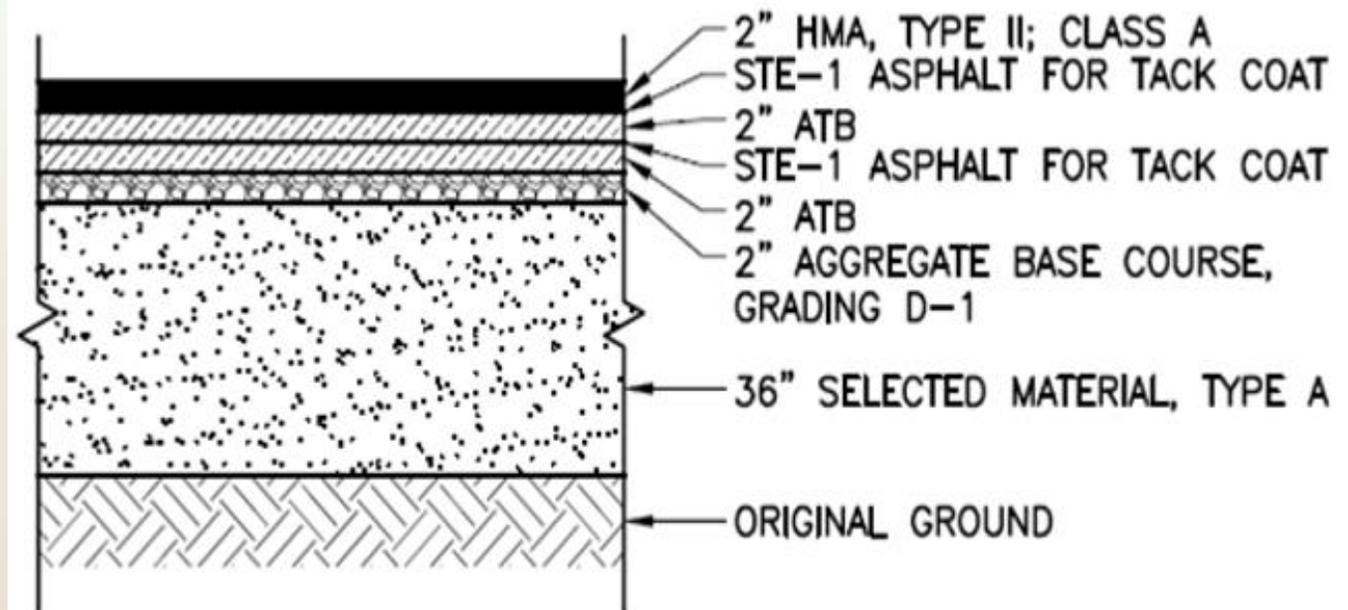
Transportation

- Alaska Preconstruction Manual
- AASHTO Green Book



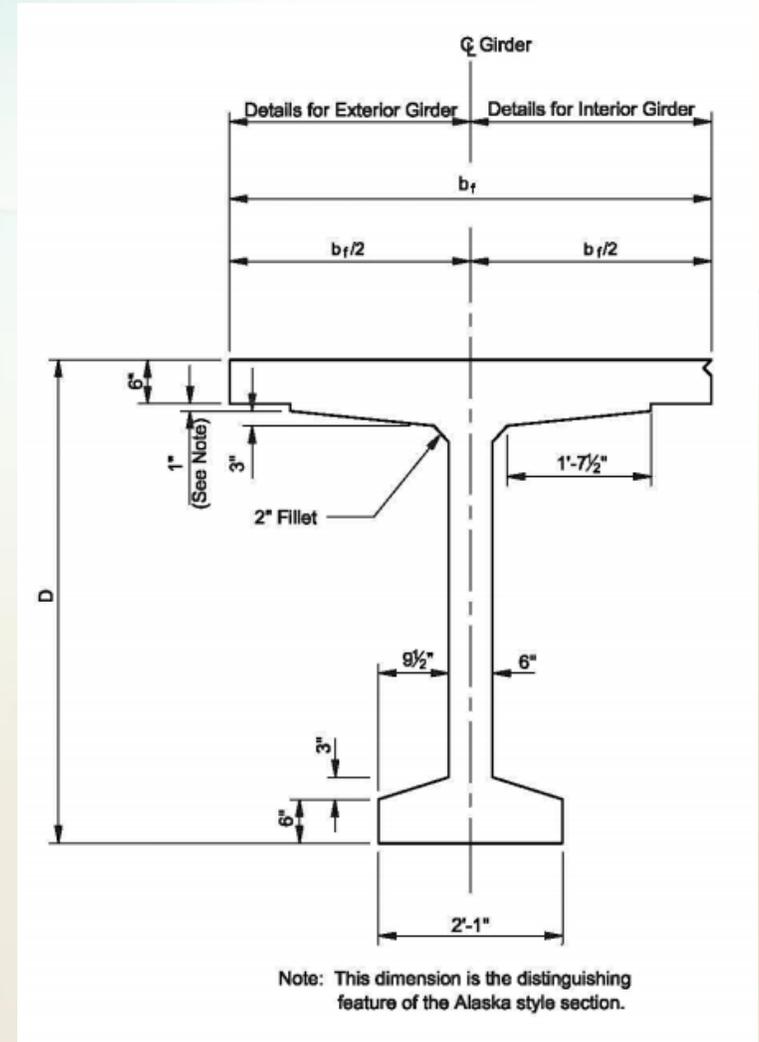
Geotechnical Findings

- Subsurface exploration
 - Soil strength parameters
 - Bearing capacities
- Liquefaction potential
 - Simplifying assumption: bedrock at 130 feet
- Steel pipe piles (API-5L)
 - No H-piles used
- Pavement Structure



Structural Findings

- Precast concrete decked bulb-tee girders
- Asphalt overlay
- Pipe pile extensions
- Number, size, and depth of piles
 - Dead and live loads
 - Soil conditions
 - Cost
- Curve on bridge: chord-offset



Hydraulic & Hydrologic Findings

- Mean High Water (MHW): 22.0'
- 100-yr flood: 21,500 cfs
- High Tide Line (HTL): 30'; low-chord on south side: 33'
- Shared use path under bridge: 25'; low-chord on north side: 35'



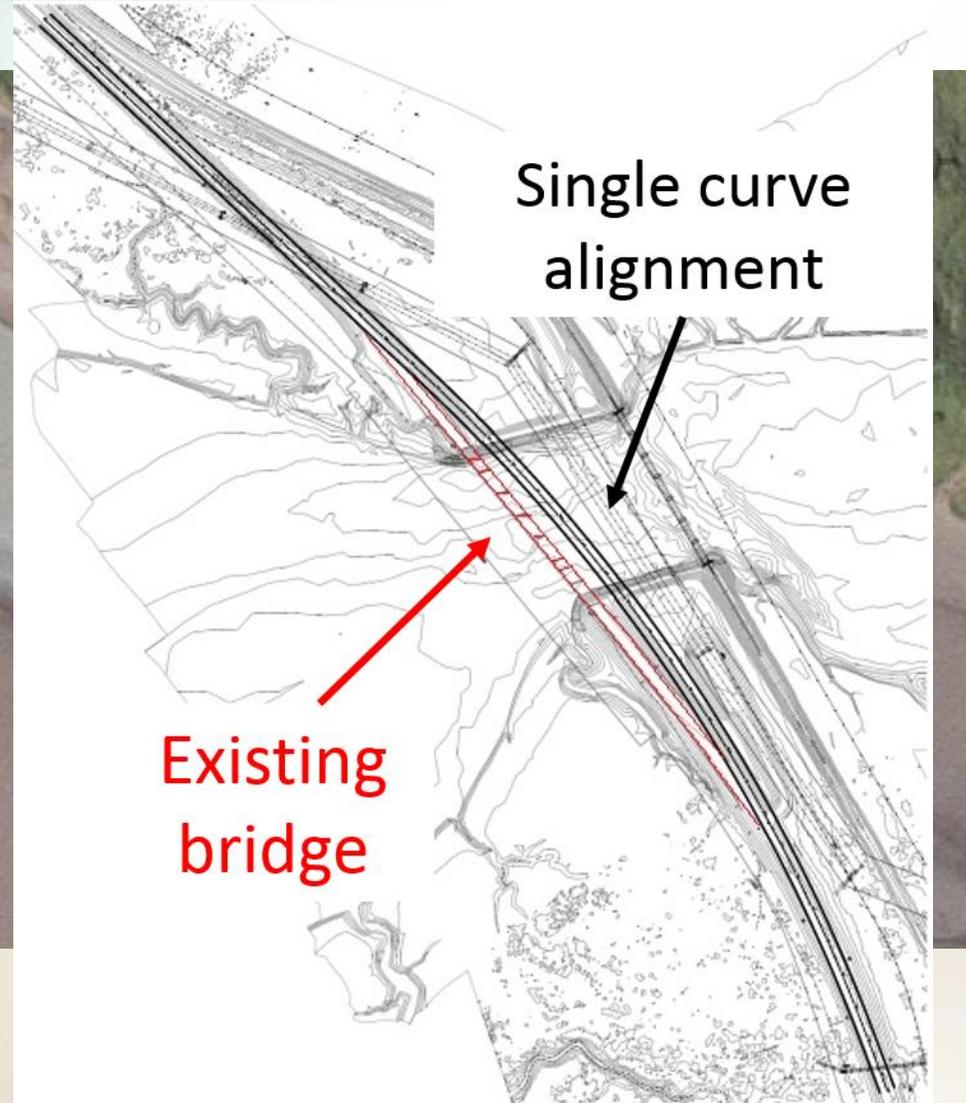
Transportation Findings

- Design speed – 65 m.p.h.
- Design year ADT – 7930 veh/day
- Minimum curve radius – 1660'
- Design K value – 193
- 12' lanes, 8' shoulders, 2% cross-slope
 - 10' shared use path on bridge

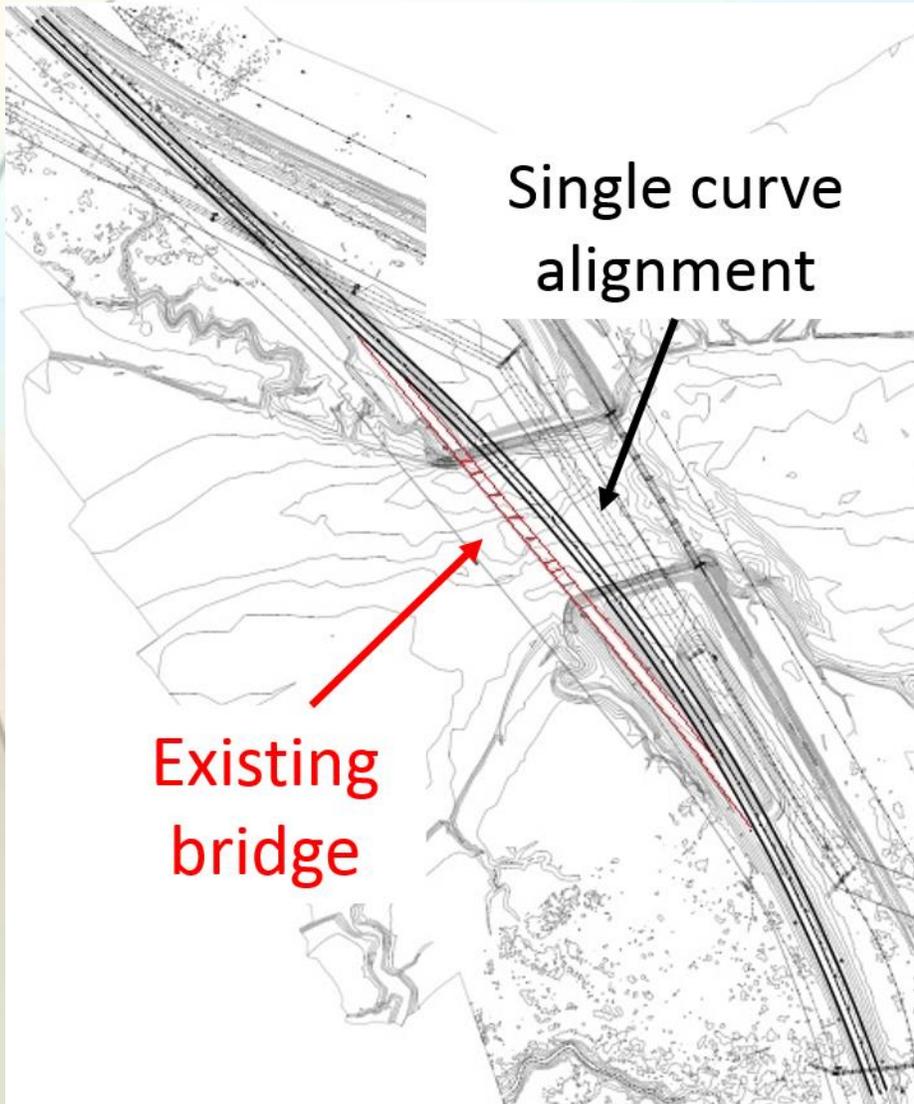


Alternatives

- No-build
- Bridge placement
- Number of spans
- Roadway alignment

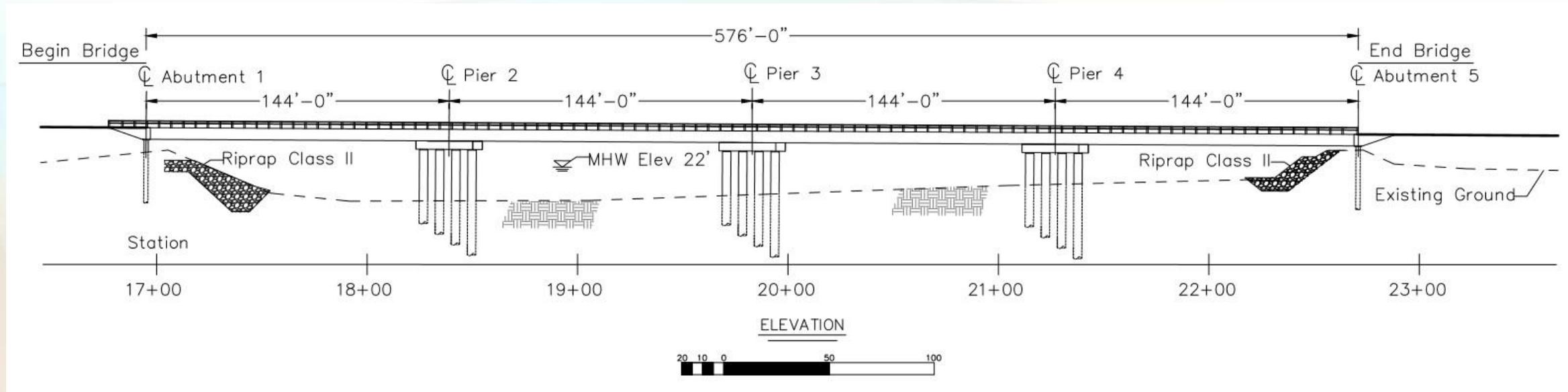


Preferred Alternative: Alignment

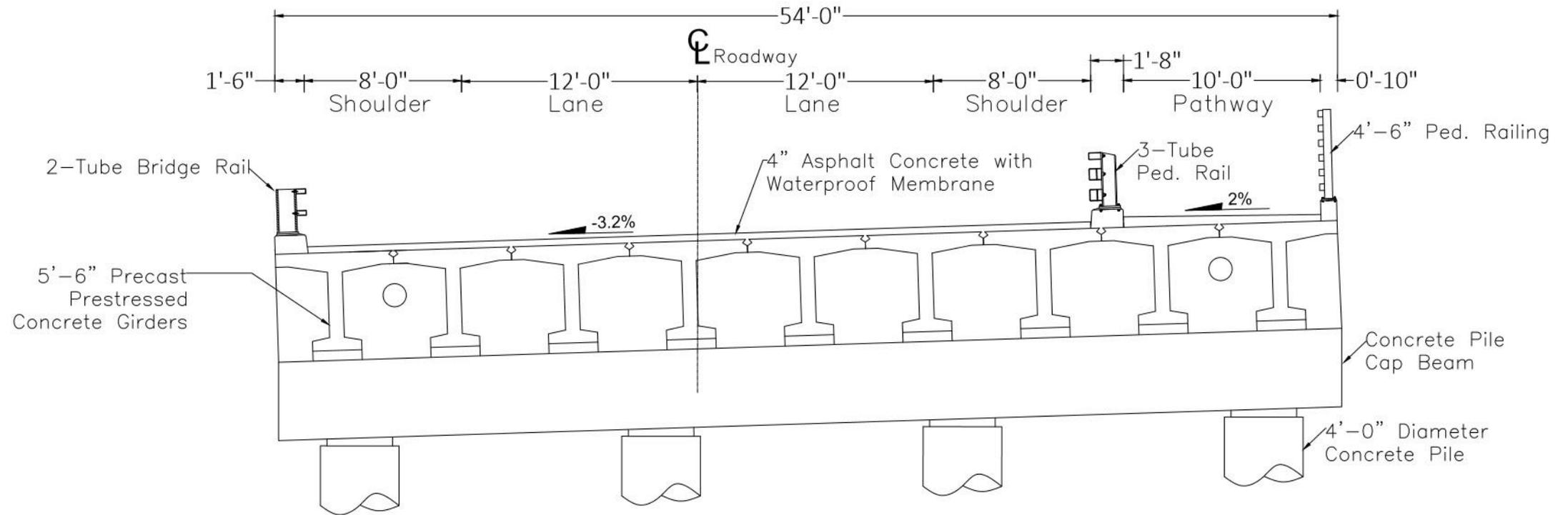


- East of existing bridge
- Single Horizontal Curve
 - 4900' radius
 - 3.2% superelevation
- Crest vertical curve north of bridge
 - Provides bridge drainage

Preferred Alternative: Bridge Configuration



Typical Section



Typical Section At Pier

No Scale

Parking Lot & Shared Use Paths

- Expand northern parking lot
- Accommodations for a future shared use path to cross under bridge
- Connection to shared use path on bridge
- Safer access to southern parking lot



Project Cost Estimate

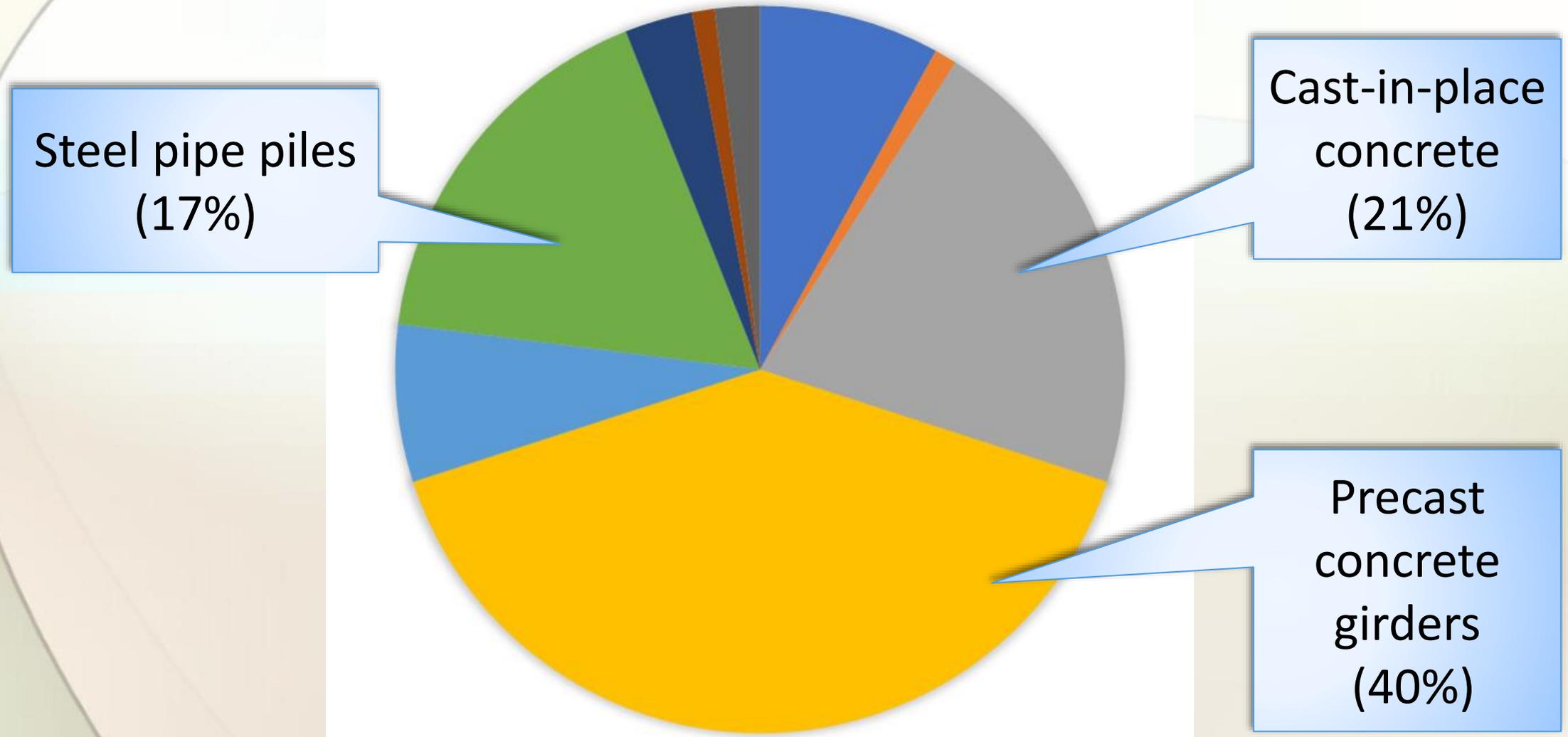
The project cost estimate is as follows:

Bridge	\$9,100,000
Roadway	\$1,900,000
Non-Material	\$7,400,000
Total	\$18,400,000

Non-material costs include:

- Mobilization and demobilization
- Contingency
- Construction engineering
- ICAP

Bridge Cost Distribution

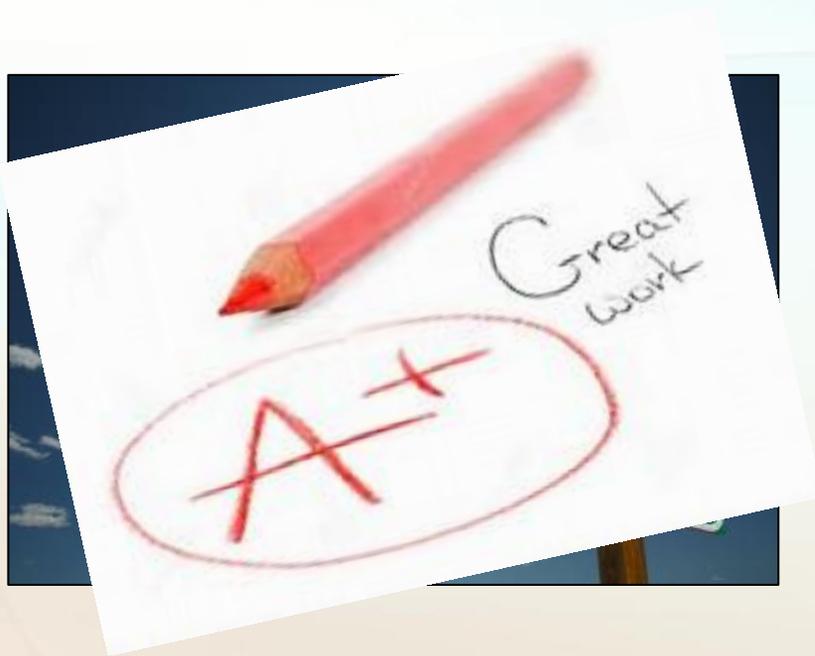


Benefits of Design

- Single horizontal curve replaces broken-back curve
- Improves pedestrian safety
 - Pathway crossing under highway
 - Shared use path accommodation on bridge
 - Expanded parking facilities
- Cost effective
- Minimizes environmental impacts
 - Minimized Scour Potential



Have we Met our Goals?



- ✓ Design a replacement bridge
- ✓ Realign the existing roadway
- ✓ Improve safety during periods of high recreational use
- ✓ Minimize environmental impacts
- ✓ Develop a realistic cost estimate

What Have we Learned?



- Time management and early deadlines contribute to success
- Experienced professionals are great resources
- Design is an iterative process
- Highway bridges are more expensive than diamonds (with a few exceptions)

Acknowledgements

- **Alaska DOT&PF**

- Sean Baski, P.E., Project Manager
- Elmer Marx, P.E., S.E., Senior Bridge Design Engineer
- Nick Murray, P.E., S.E., Bridge Design Engineer
- David A. Hemstreet, P.E., G.E., State Foundation Engineer

- **HDR**

- Matt Stone, P.E., Roadway Lead / Senior Project Manager
- Trent Parks, Transportation EIT

- **UAA**

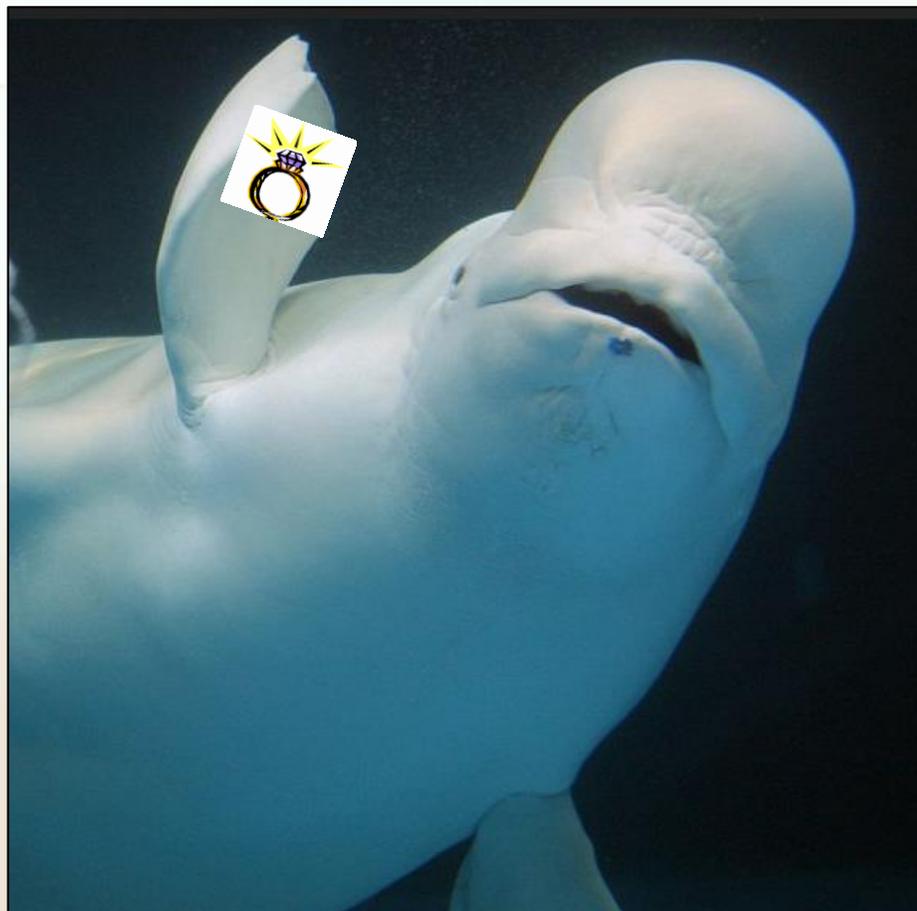
- Osama Abaza, Ph.D., Professor of Civil Engineering
- Joey Yang, Ph.D., Professor of Civil Engineering



Resources

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Questions?



Thanks for being
such a good
audience!