Surfside Beach Fishing Pier – Value Engineering (VE) Design

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INFRASTRUCTURE CONSULTING & ENGINEERING

Fishing Pier Location

Surfside Beach, South Carolina

Owner

Damaged Fishing Pier

Post Hurricane Matthew (2016)

FEMA Grant to Town of Roughly $10M to replace

Original Design Conditions

Increase Deck Elevation by 10 feet

Must be concrete foundations

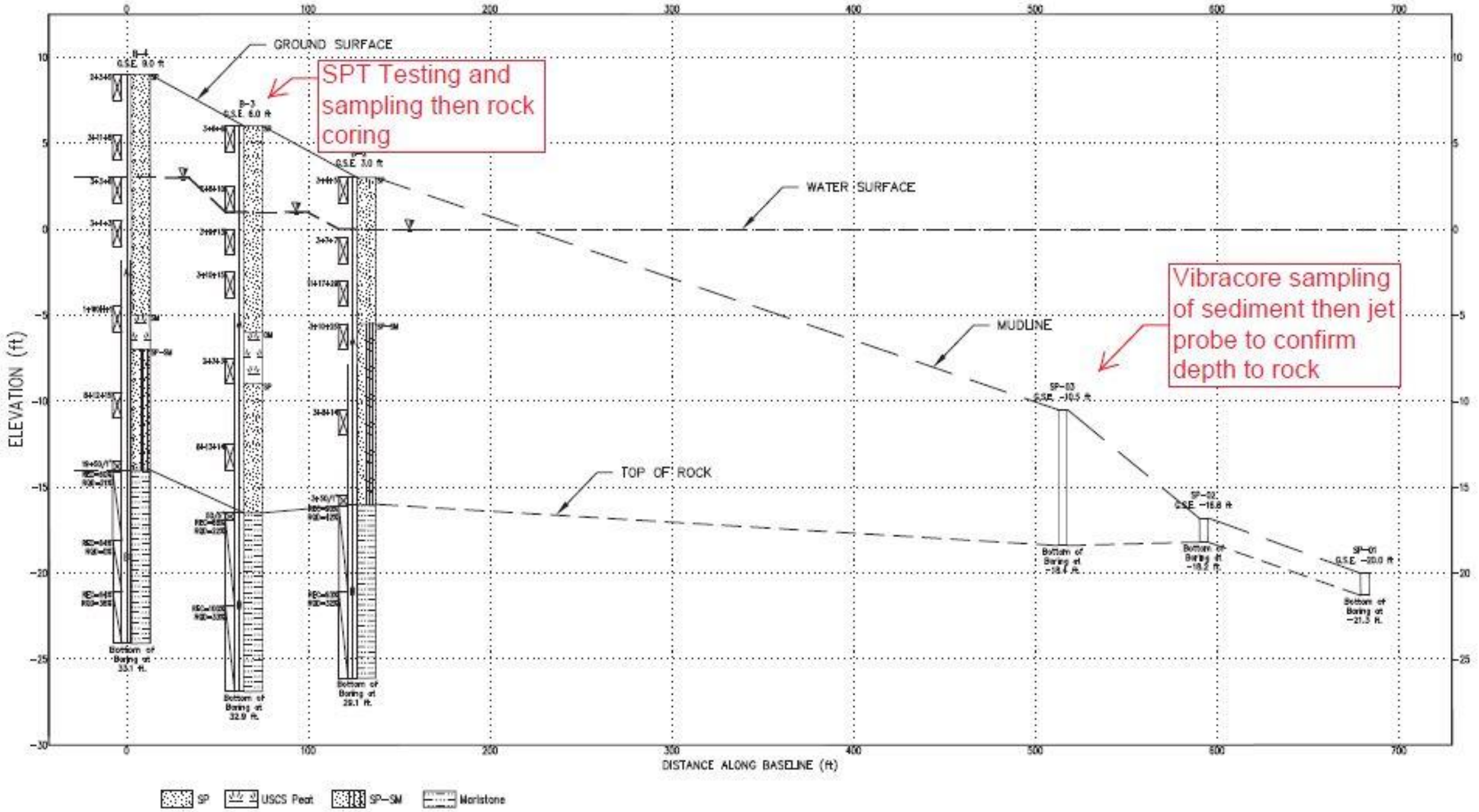
Difficult local geology

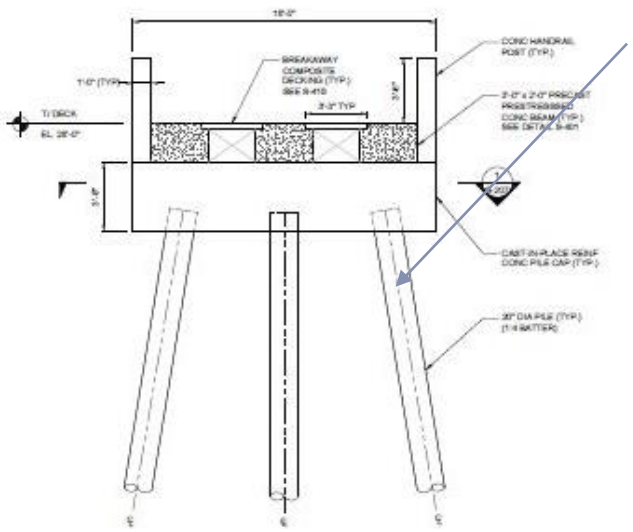
Complex wave/seismic loading

Highly corrosive marine environment

Rock Cores from Original Geotech Report

From Prebid Geotech Report

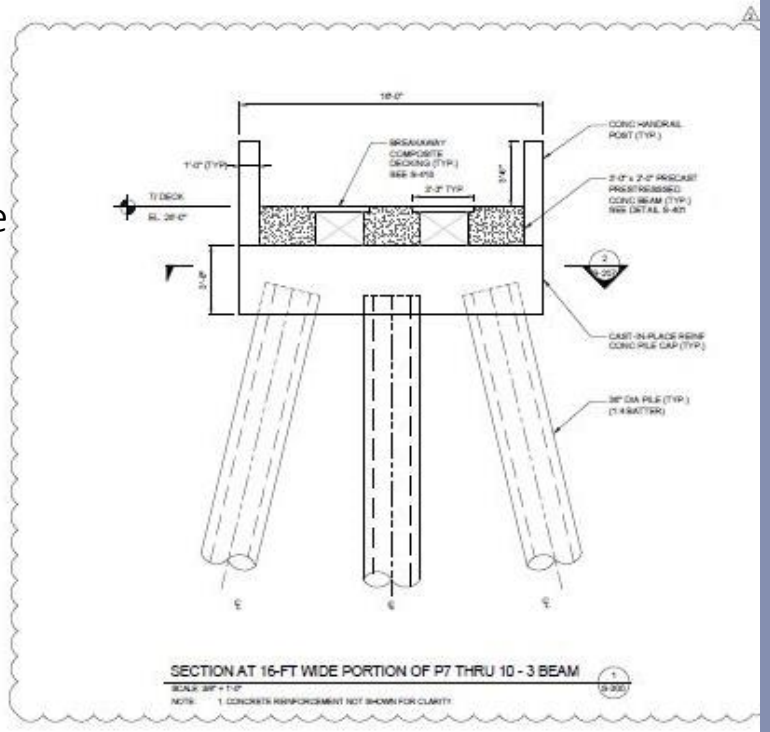




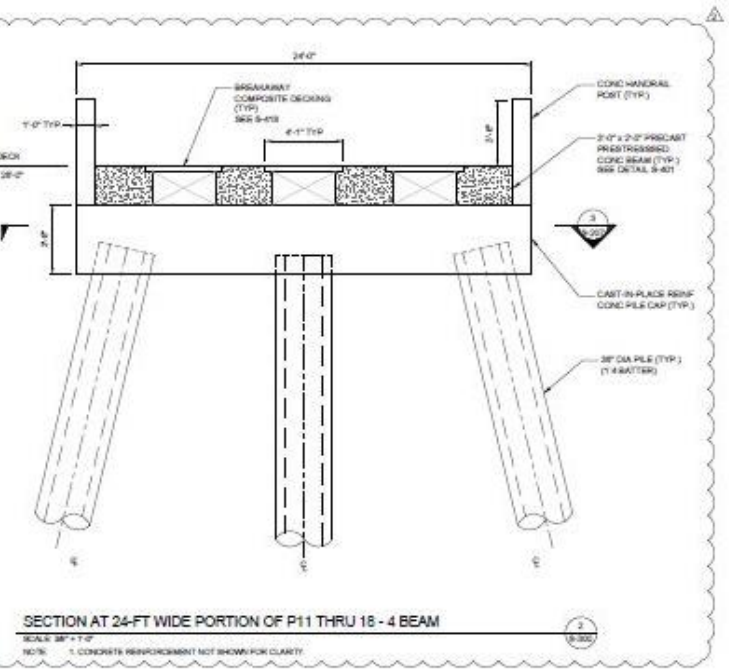
SECTION AT 16-FT WIDE PORTION OF P1 THRU P6 - 3 BEAM

20” Dia. Solid Concrete Piles with 12” pipe stinger

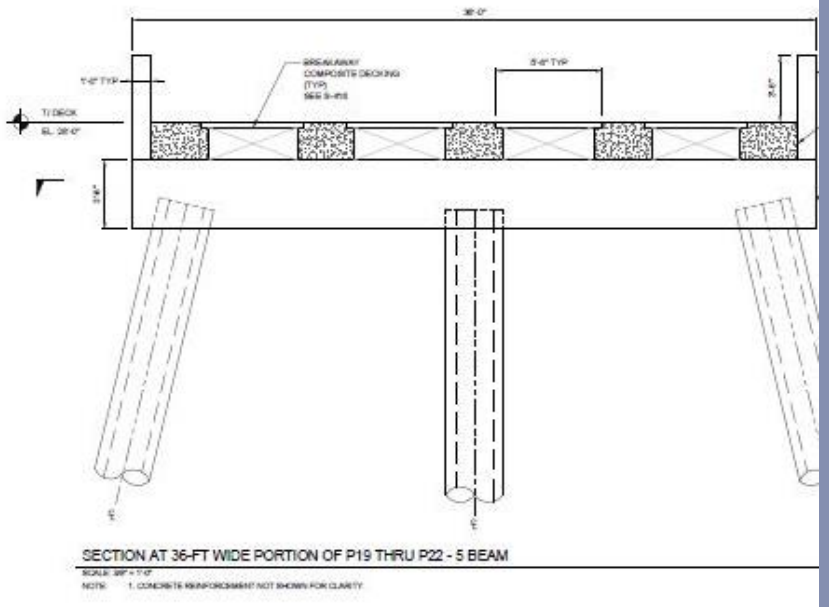
Rock



SECTION AT 16-FT WIDE PORTION OF P7 THRU 10 - 3 BEAM



SECTION AT 24-FT WIDE PORTION OF P11 THRU 18 - 4 BEAM



SECTION AT 36-FT WIDE PORTION OF P19 THRU P22 - 5 BEAM

Original Design Details

Battered concrete foundations

20” (P1 to P6) to 36” diameters

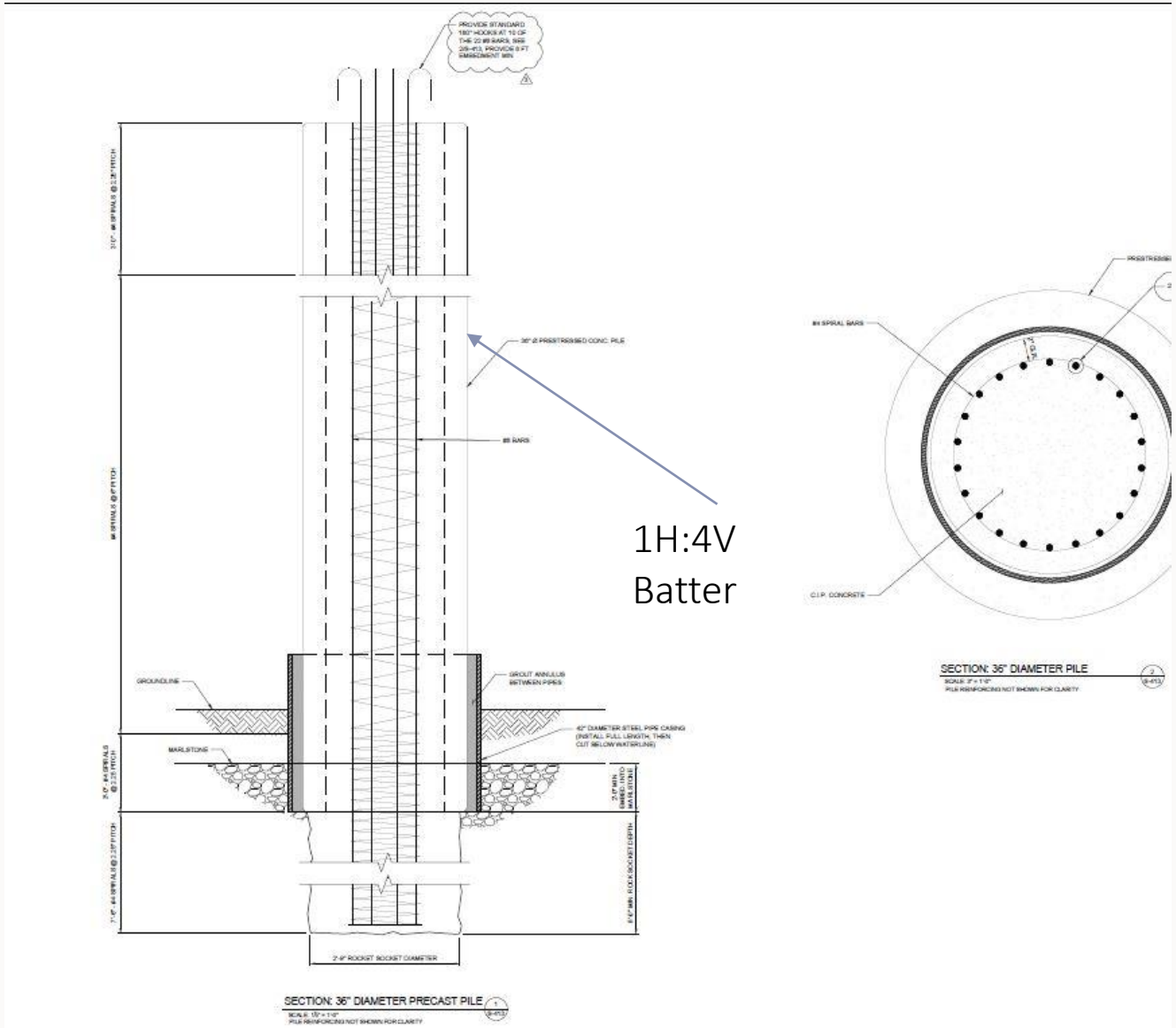
Drilled-in Pile (P7 to P22)

Three Piles per bent

8-foot penetration into marlstone

22 total bents

Precast Beams



Original Design Details

Multi step construction process for Pier Bents 7 to 22

-Outer steel casing 2’ into rock

-Clean out

-Set 36” Concrete Cylinder Pile

-Grout annulus

-Drill 8’ socket into rock

-Set cage

-Concrete

Selected Construction Team

Prime Contractor

Foundation and Pier Subcontractor

Value Engineering Structural and Geotechnical Engineer for Fishing Pier

VE Design Conditions

Increase Deck Elevation by 10 feet

Must be concrete foundations

Difficult local geology

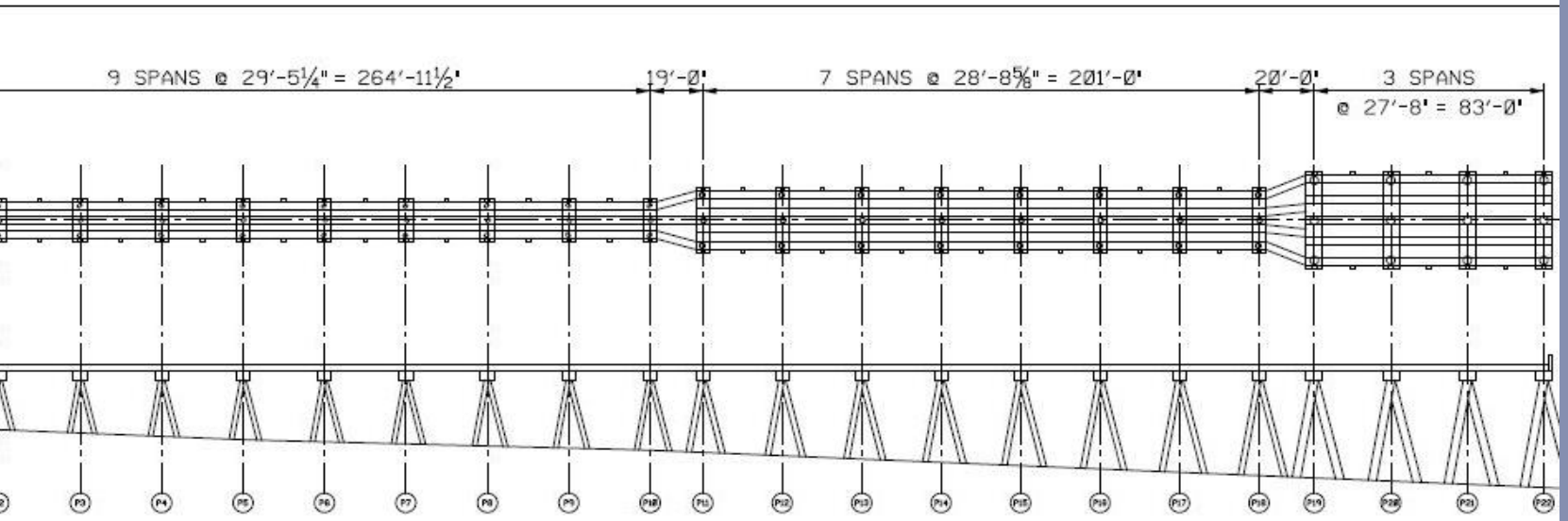
Complex wave/Seismic Loading

Highly corrosive marine environment

Same footprint as original

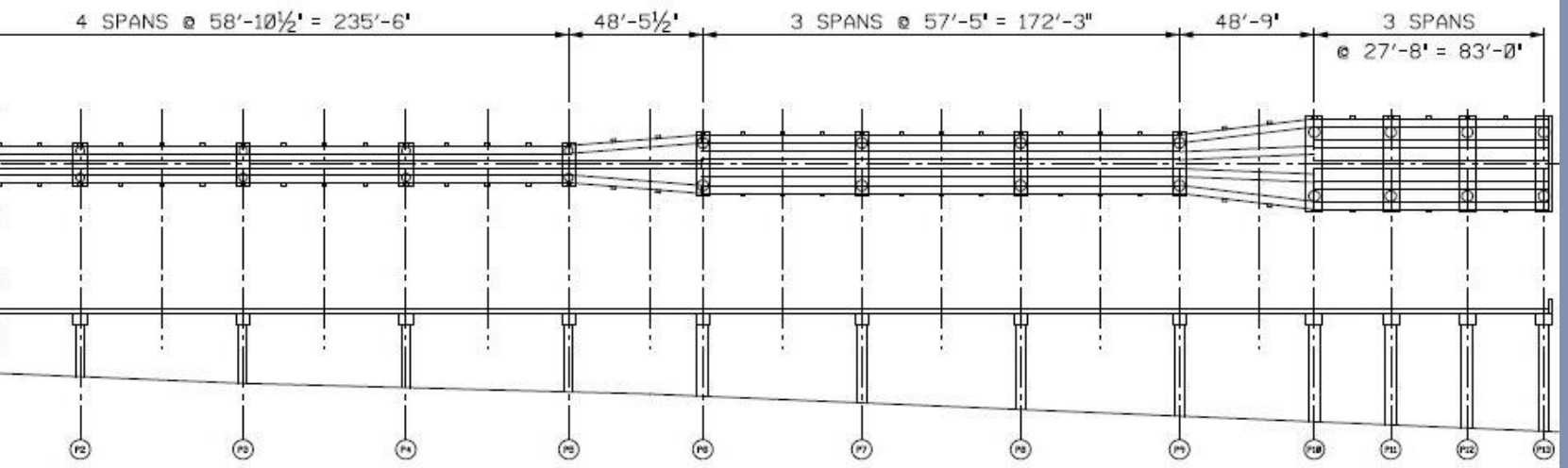
Vertical foundations

Driven foundations



Original Design

ELEVATION - AS BID PLANS



VE Design

ELEVATION - VE PROPOSAL

PRELIMINARY PLANS
FOR INFORMATION ONLY
DO NOT USE FOR CONSTRUCTION

ICE of CAROLINAS, PLLC
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4505 Falls of Neuse Road, Suite 110
Raleigh, North Carolina 27609
Phone: 803-822-0333
License #: P-0999

JOB: SURFSIDE PIER
SUBJECT: VALUE ENGINEER
PREPARED BY: PWG DATE: 10
CHECKED BY: _____ DATE: _____

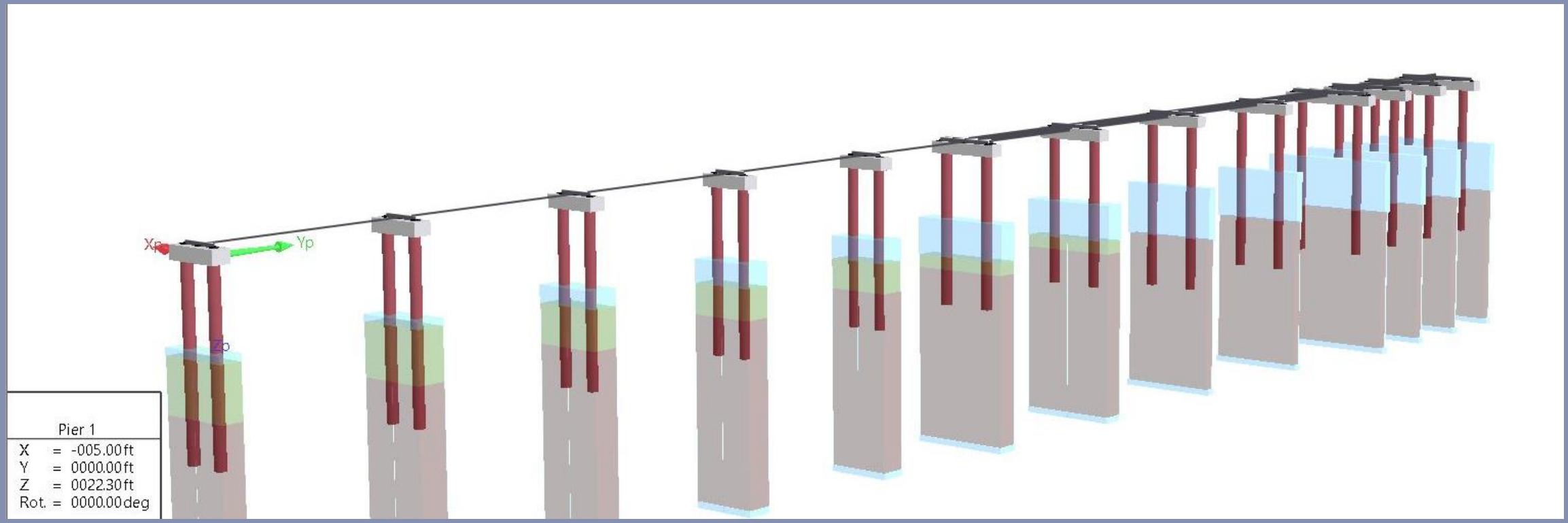
VE Concept

Original design (22 bents w/ 3 piles each)

and

VE design (13 bents w/ 2 piles each)

~3200 LF of Pile vs ~1600 LF of Pile***



VE 3-D Modeling

With FB-Multipier

42" Pipe pile NO SCOUR

Hammer Information

Select from following list [10/17/2016-2003]: ID: 583

ID	Name	Type	Ram Wt/Ecc. M.	Energy/Power
582	APE D 125-42	OED	27.563	310.084
583	APE D 50-42	OED	11.025	124.031
584	APE D 12-42	OED	2.646	29.767

Hammer parameters

Efficiency	0.8			
Pressure	1160	psi	Fixed 73	%
Stroke	11.25	ft	Variable	

Ultimate Capacities (up to 10)

kips

1	500.0	6	1100.0
2	568.0	7	1250.0
3	611.0	8	1400.0
4	800.0	9	1550.0
5	950.0	10	1700.0

Incr. 0 Action >>

Pile material

Concrete Steel Timber

Cushion Information

	Hammer	Pile	
Area	491.	0.	in^2
Elastic Modulus	285.	0.	ksi
Thickness	3.5	0.	in
C.O.R.	0.8	0.	
Stiffness	0.	0.	kips/in
Helmet Weight	7.		kips

Soil Parameters

2nd Toe - No

Quake

Shaft 0.1 in Const

Toe 0.1 in

Damping

Shaft 0.13 s/ft Const

Toe 0.15 s/ft Smith

Pile Information

Length	65.	ft	Auto	Segments
Penetration	30.	ft	Auto.	S-Length
Section Area	128.8	in^2	Auto.	S-St, Wt
Elast Modulus	29000.	ksi	0	Splices
Spec Weight	492.0	lb/ft^3		
Toe Area	128.8	in^2	Pile Type:	
Perimeter	10.995	ft	Pipe	
Pile Size	42.	in		

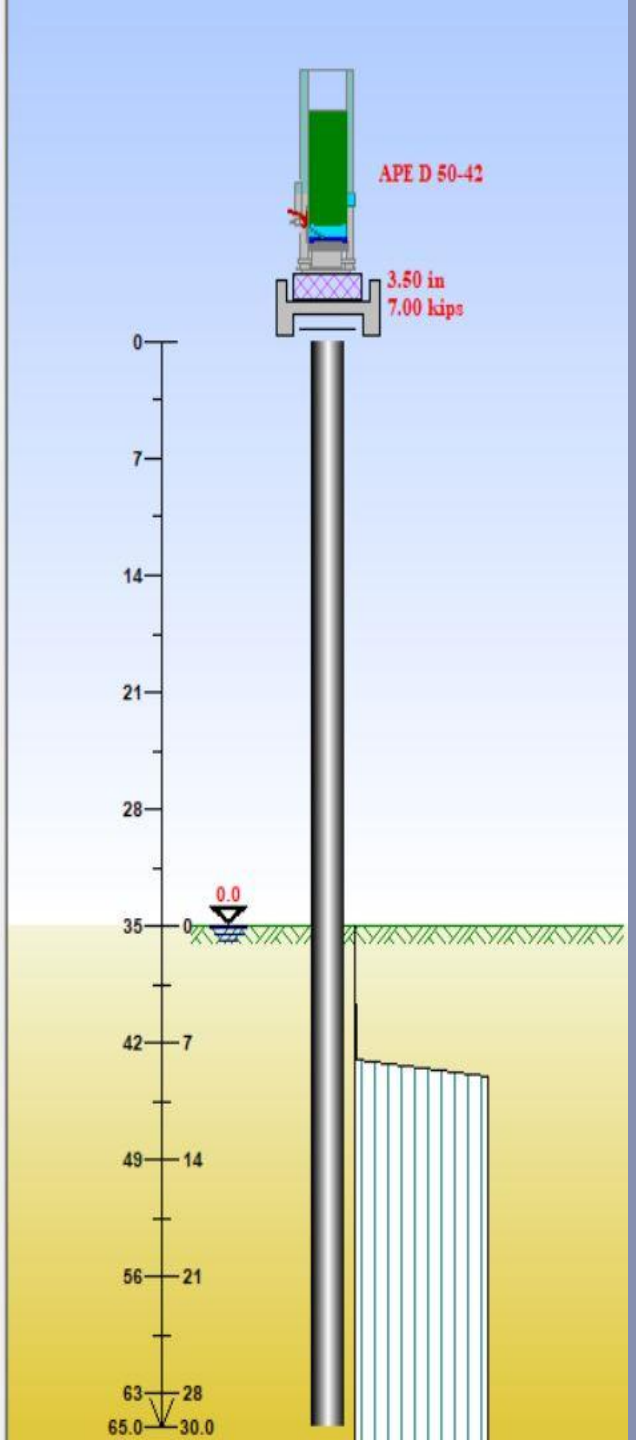
Shaft Resistance

Percentage 95 %

100%

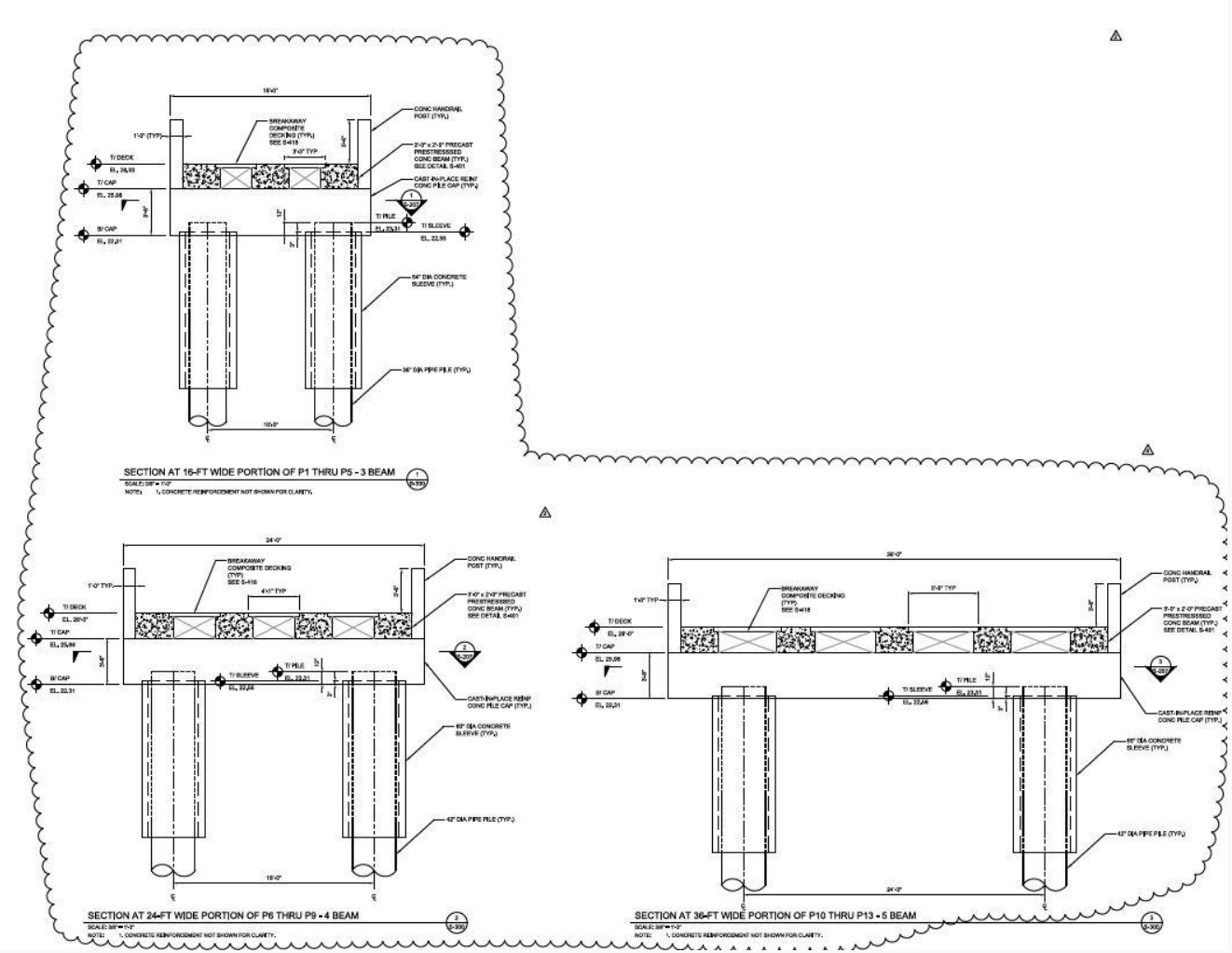
Dist. Shape Num 0.0

Residual Stress Analysis: No



VE Constructability

Model and properly size contractors' equipment with GRLWEAP



VE Design Details

Vertical foundations

Steel foundations

36 to 42” diameters

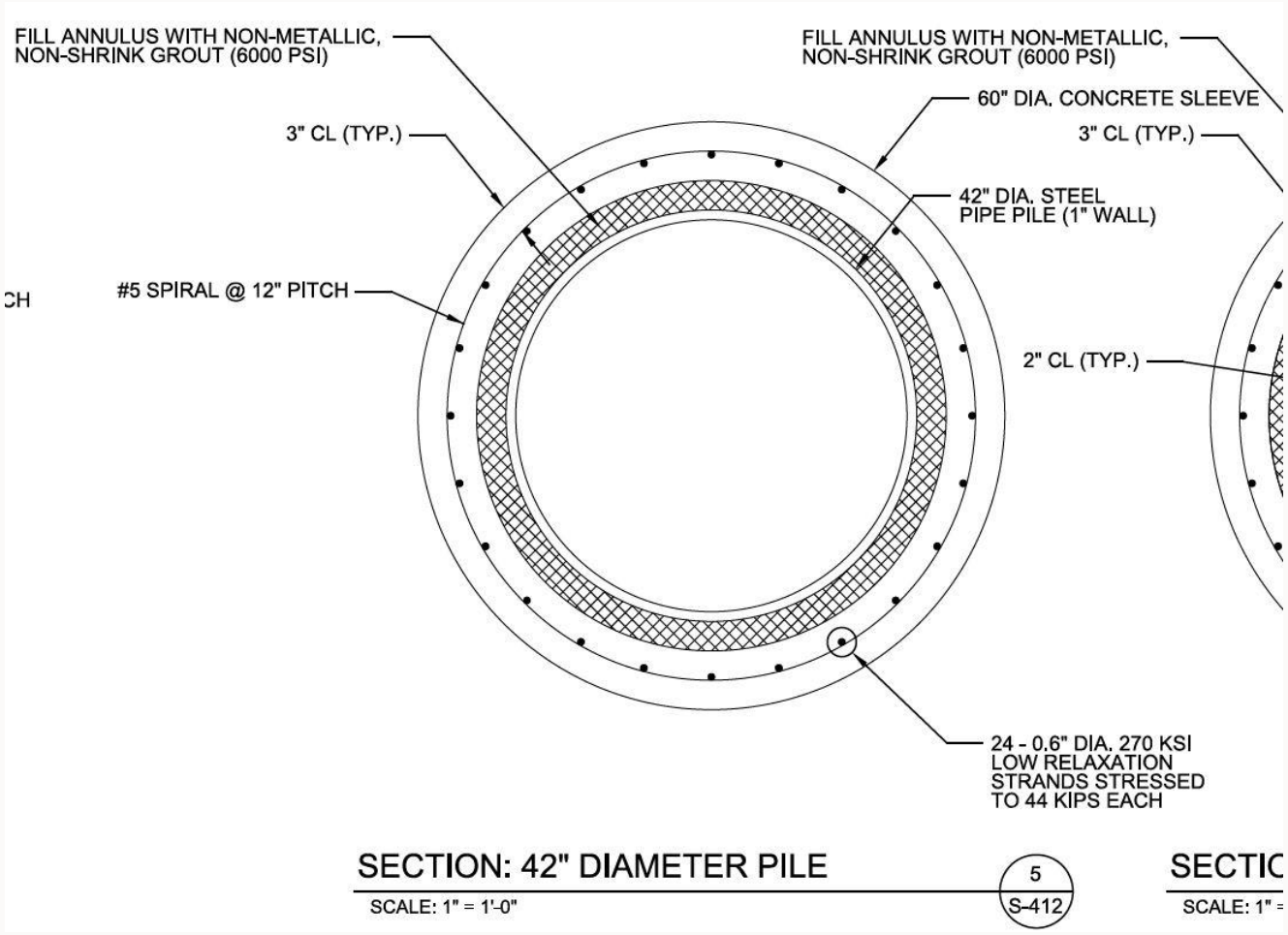
Driven pile (contingency drilling)

Two piles per bent

Up to 22-foot penetration into marlstone

13 total bents

Similar Precast Beams



VE Design Details

Steel Piles w/ corrosion protection coatings

Concrete sleeve

Grout corrosion protection

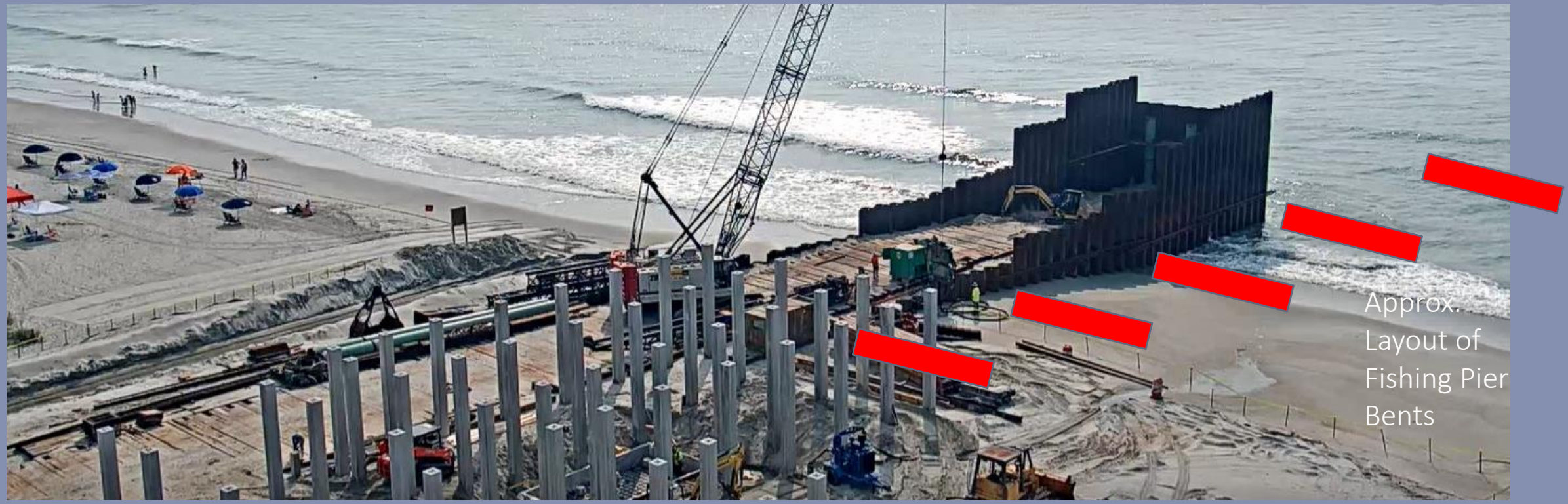
PIER	AXIAL-CAPACITY (ASD)	MIN PILE TIP EL (FT)
1 TO 5	235 KIPS	-31
6 TO 7	303 KIPS	-35
8 TO 9	284 KIPS	-37
10 TO 13	284 KIPS	-40

PILE TABLE OF VARIABLES							
PILE CAP NO.	MUDLINE EL. (FT.)	PILE DIA. (IN.)	SLEEVE DIA. (IN,)	LP (FT.)	EL. P (FT.)	LS (FT,)	EL. S (FT,)
P1	4	36	54	55	-31	35	-12
P2	2	36	54	55	-31	37	-14
P3	-1	36	54	55	-31	39	-16
P4	-2	36	54	55	-31	39	-16
P5	-3	36	54	55	-31	39	-16
P6	-5	42	66	59	-35	39	-16
P7	-7	42	66	59	-35	39	-16
P8	-11	42	66	61	-37	41	-18
P9	-15	42	66	61	-37	41	-18
P10	-20	42	66	64	-40	44	-21
P11	-20	42	66	64	-40	44	-21
P12	-20	42	66	64	-40	44	-21
P13	-20	42	66	64	-40	44	-21

P = Pipe Pile
S = Sleeve

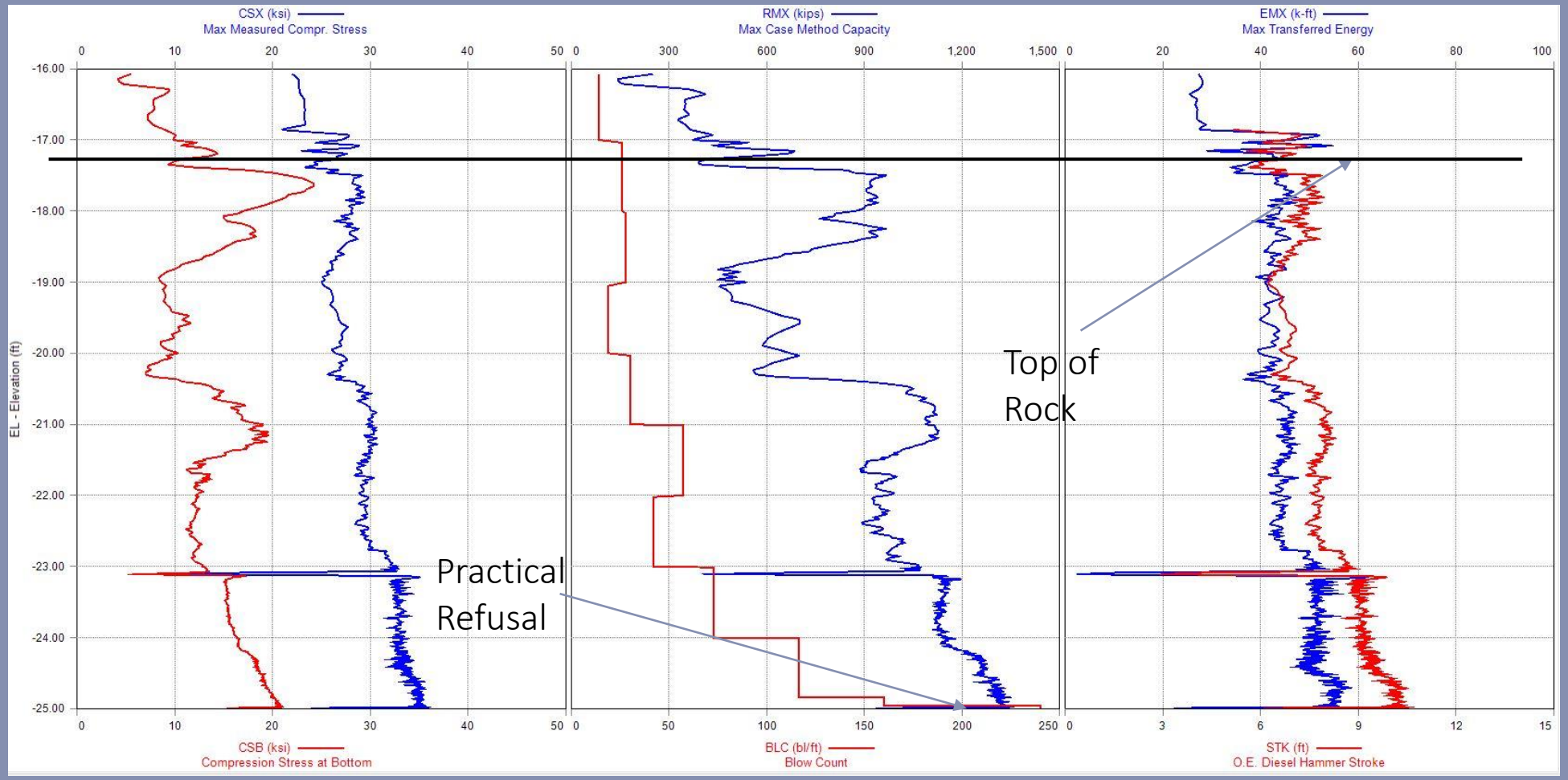
VE Design Details

- Plan Axial Capacities
- Plan Min. Pile Tip Elev.
- Bent/Pier 1-5 36” Piles
  - ~15’ min Embedment into Marlstone
- Bent/Pier 6-13 42” Piles
  - ~19-22’ min. embedment into Marlstone
- Drive to FS of 2.0 with PDA Testing/WEAP
- Predrill if can’t be installed by driving



Summer 2021 – VE Design Ongoing

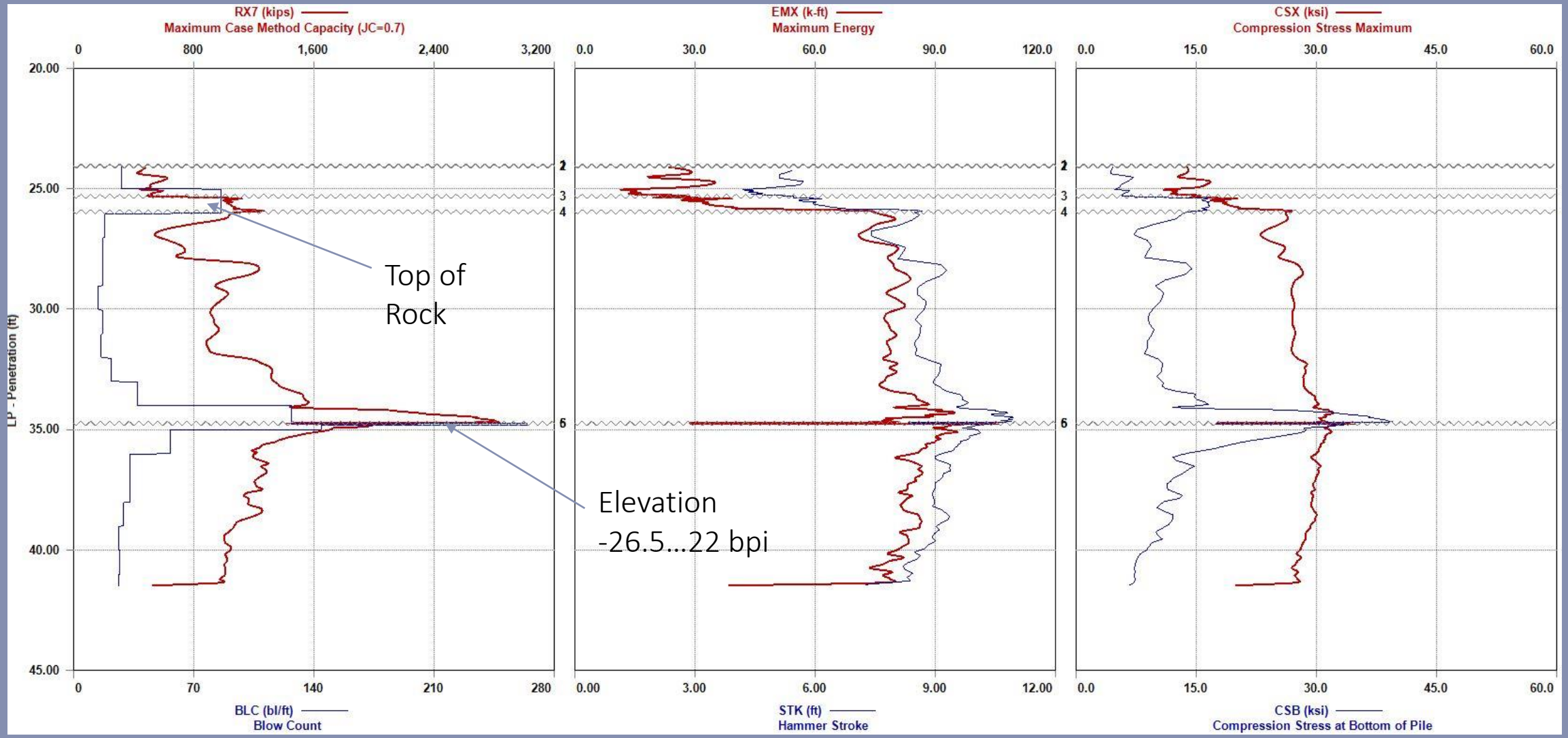
Picture Courtesy of Surfside Beach Oceanfront Hotel Webcam



PP30x0.529
APE D50-42

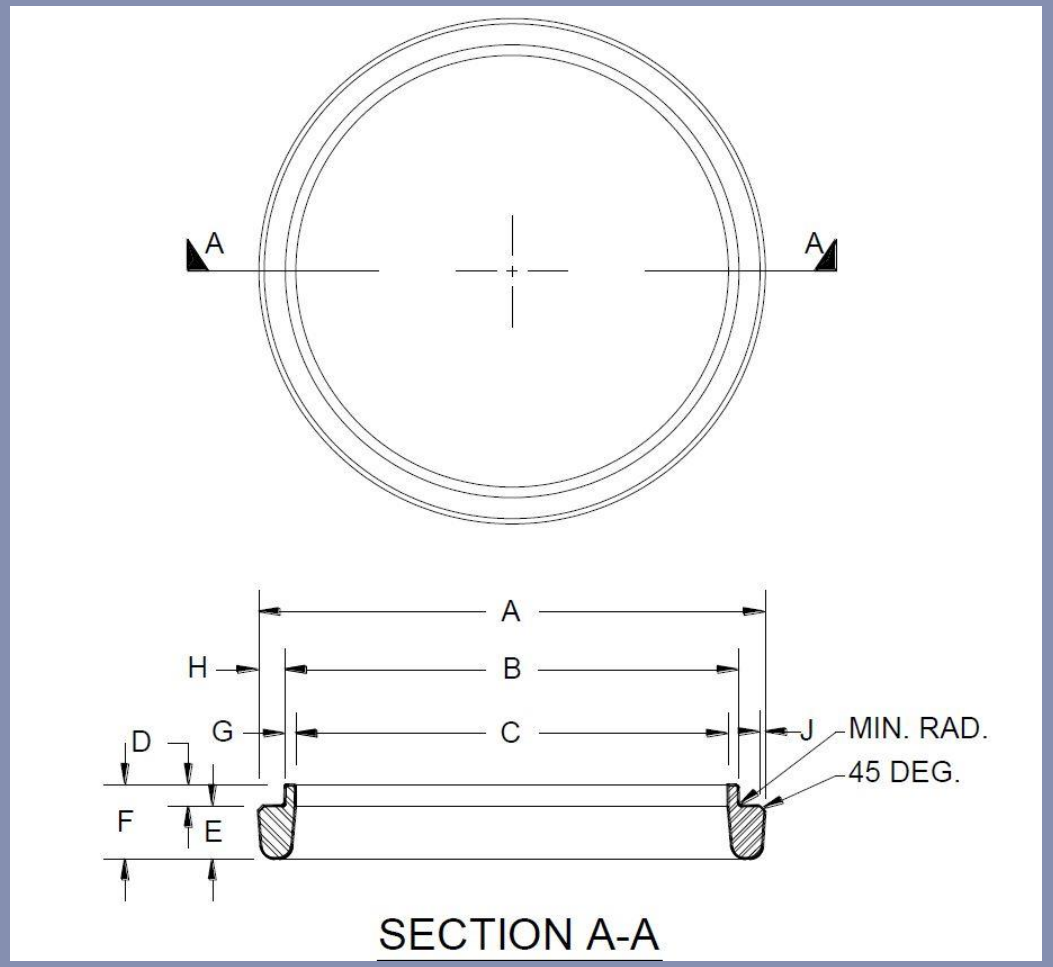
PDA Results First Trestle Pile

PP36x0.741 with outside fit shoe
APE D80-42

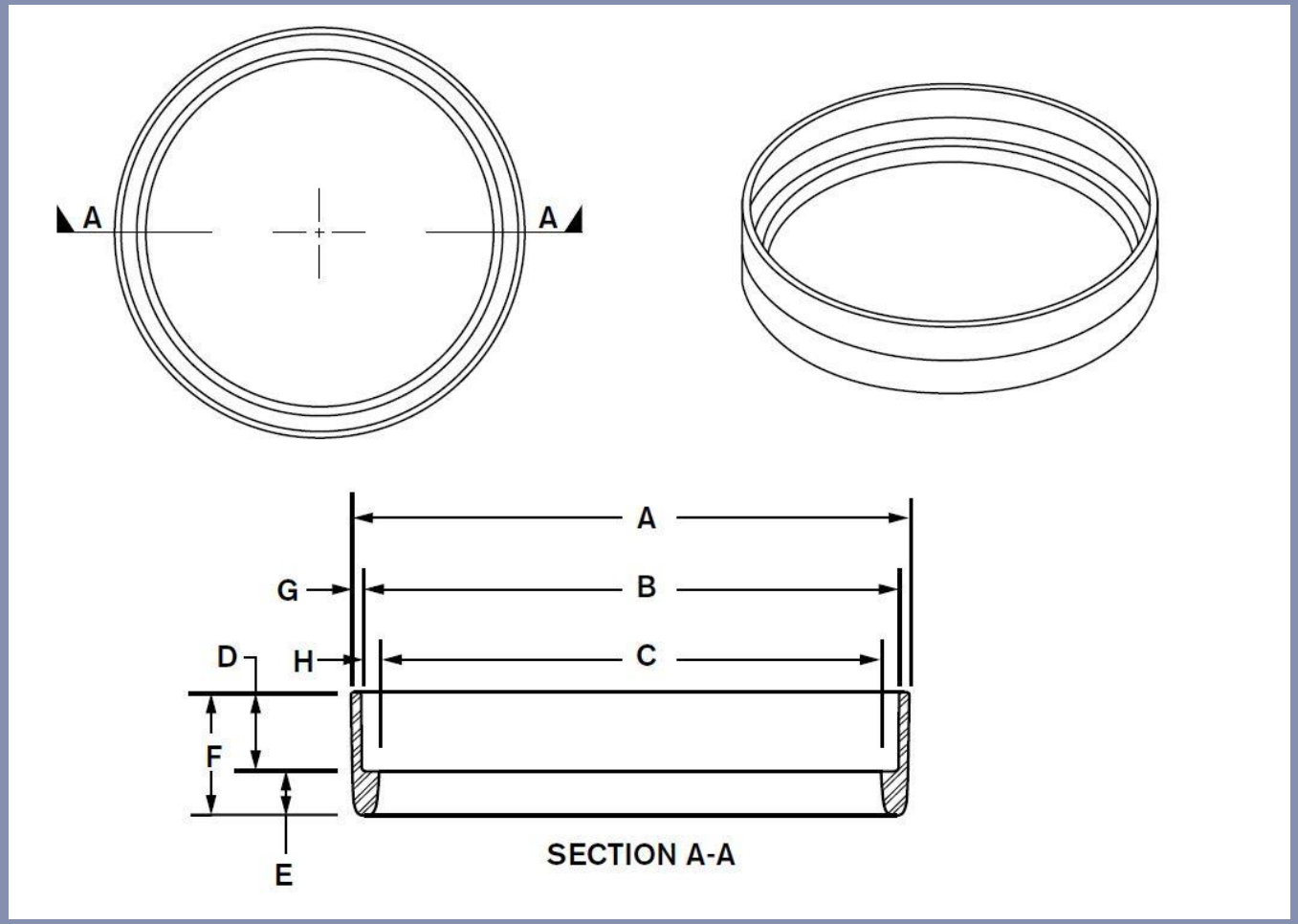


PDA Results First Production Pile (11/17/21)

Inside Fit (42” Pipes Bents 7 to 13



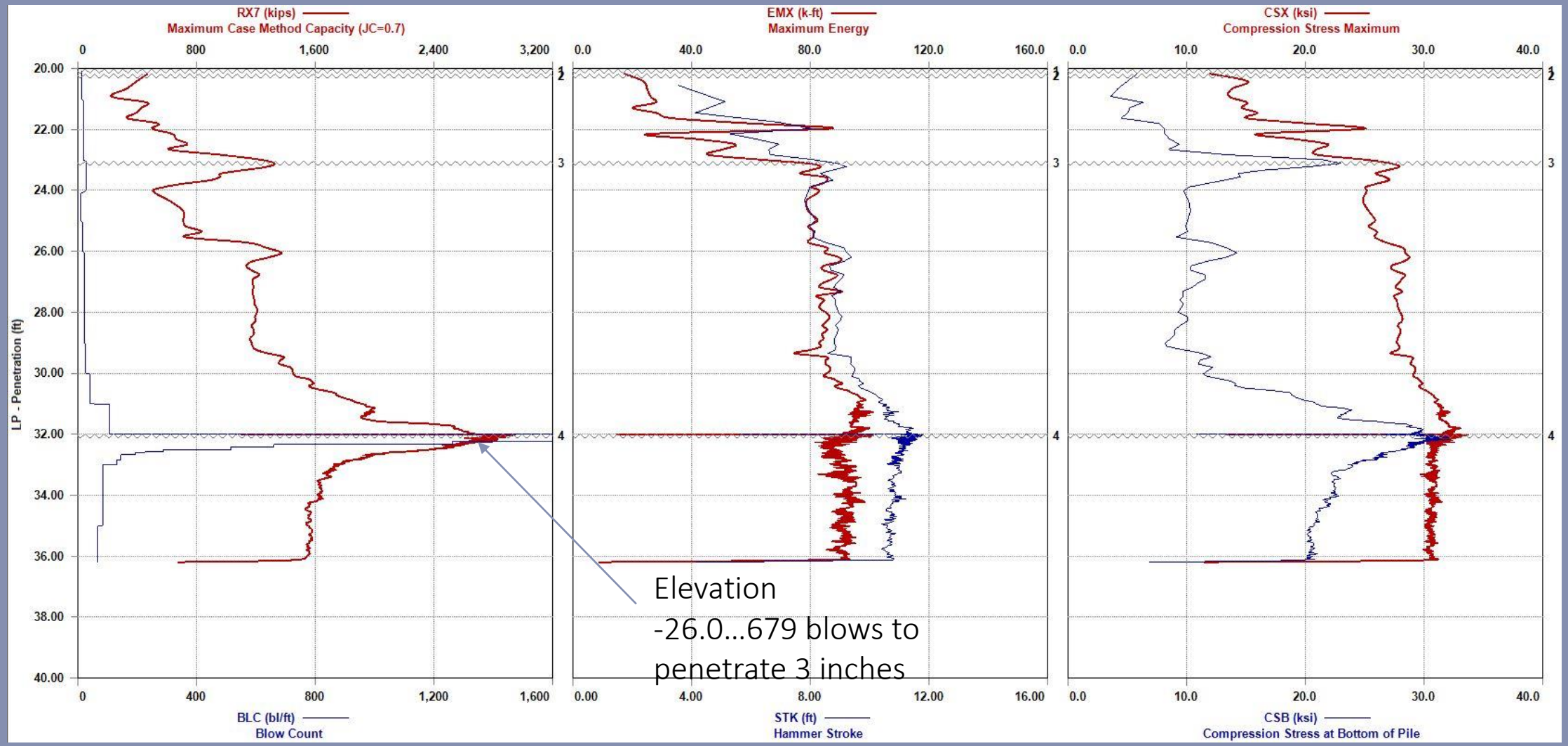
Outside Fit (36” pipes Bent 1 and 3 to 6)



Pipe Pile Cutting Shoes

Pipe Pile Cutting Shoes

PP36x0.741 with no cutting shoe
APE D80-42



PDA Results Bent 2 (No shoes)

Current Progress

September 2022

Current Progress

September 2022

Current Progress

September 2022

Current Progress

September 2022

Current Progress

September 2022

Current Progress

September 2022

-4-6 piles remaining

-Relatively easy driving (<50 bpf) barring thin hard layer at Elevation -26 to -27 ft at near practical refusal

-No contingency drilling needed

-Likely pile overrun at last 4 bents to meet axial load (like end of work trestle)

-Did do long term restrike (1 week) at end of work trestle, little to no setup

Current Progress

Hurricane Ian (9/30/22)

Picture Courtesy of Surfside Beach Oceanfront Hotel Webcam

Overall Original Design vs. VE

-Cost Savings? Likely Yes**

-Time Savings? Yes

-Better aesthetics? Maybe

-Did we add value??

Questions?