CABES

CALIFORNIA BRIDGE ENGINEERS SEMINAR

ADVANCING BRIDGE ENGINEERING THROUGH INNOVATION

Caltrans

CABES 2026

Presentation 9 - From Blueprint to Bedrock

DES
DIVISION OF ENGINEERING SERVICES

From Blueprint to Bedrock: A Case Study on the Design and Execution of CIDH Foundations in Bridge Projects

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Structure Construction – Caltrans

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Contents

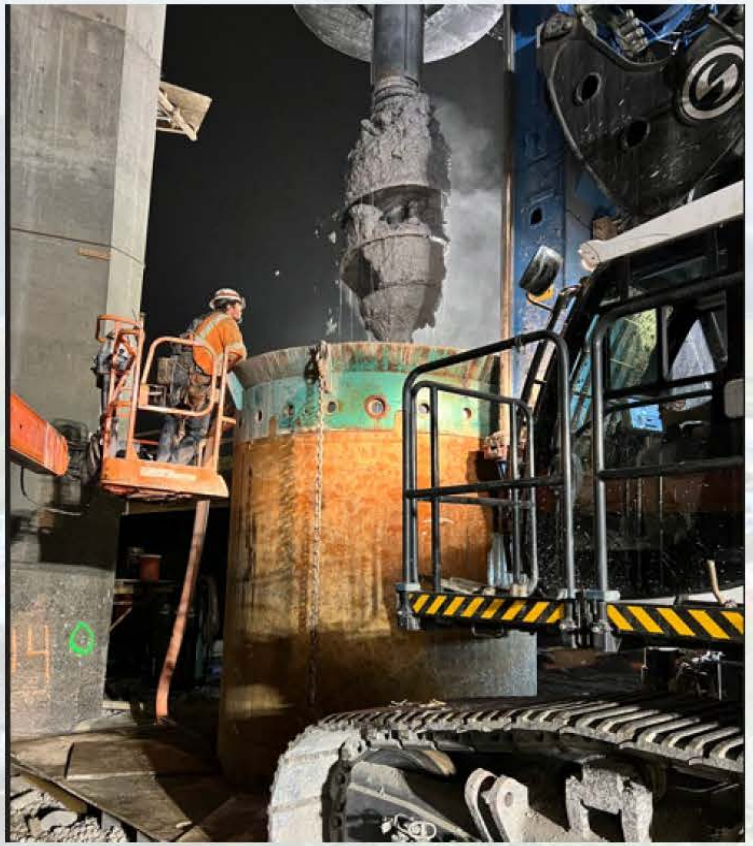
- Project overview
- CIDH – An introduction
- Design CIDH – Blueprint
- Proposed change
- CIDH Installation methodology – Bedrock
- Comparison
- Results & significance
- Conclusion

Project Overview

- Dr. Fine bridge replacement on state highway 101 in Del Norte county.
- 4 span, single frame structure.
- Length 1031ft long.
- Width 51ft, 2 travel lanes.
- Superstructure- PS CIP box girder.
- Schedule driven – 7 workday calendar.

CIDH – An Introduction

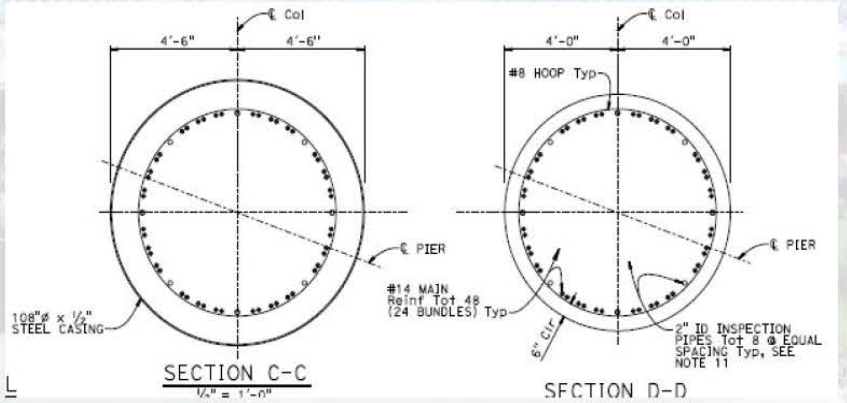
- Cast-in Drilled Hole piles (CIDH) are deep foundational elements.
- It is a replacement pile.
- A typical bridge foundation for cohesive soils, granular soils.
- Load transfer mechanism – End bearing and Skin friction.
- Designed for ultimate and serviceability limit states.
- Vital role in importance in bridge performance.

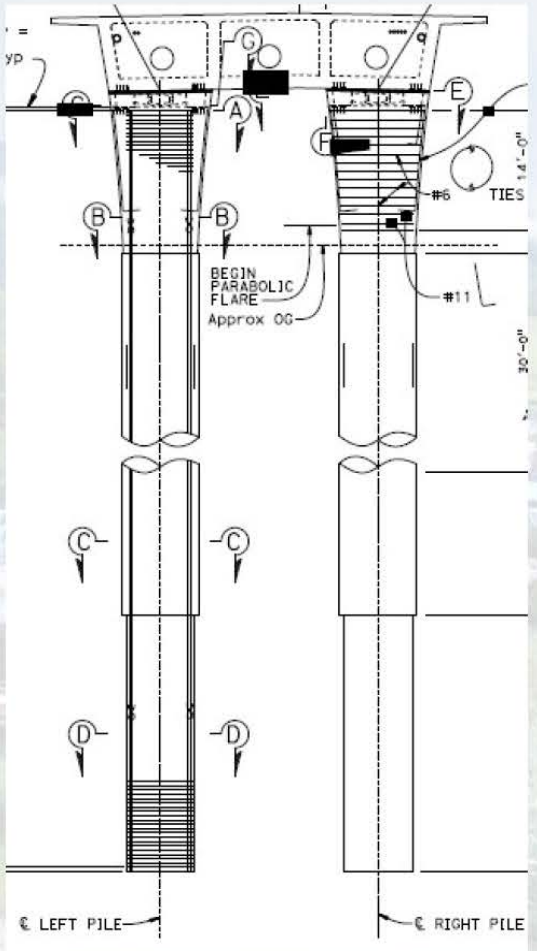


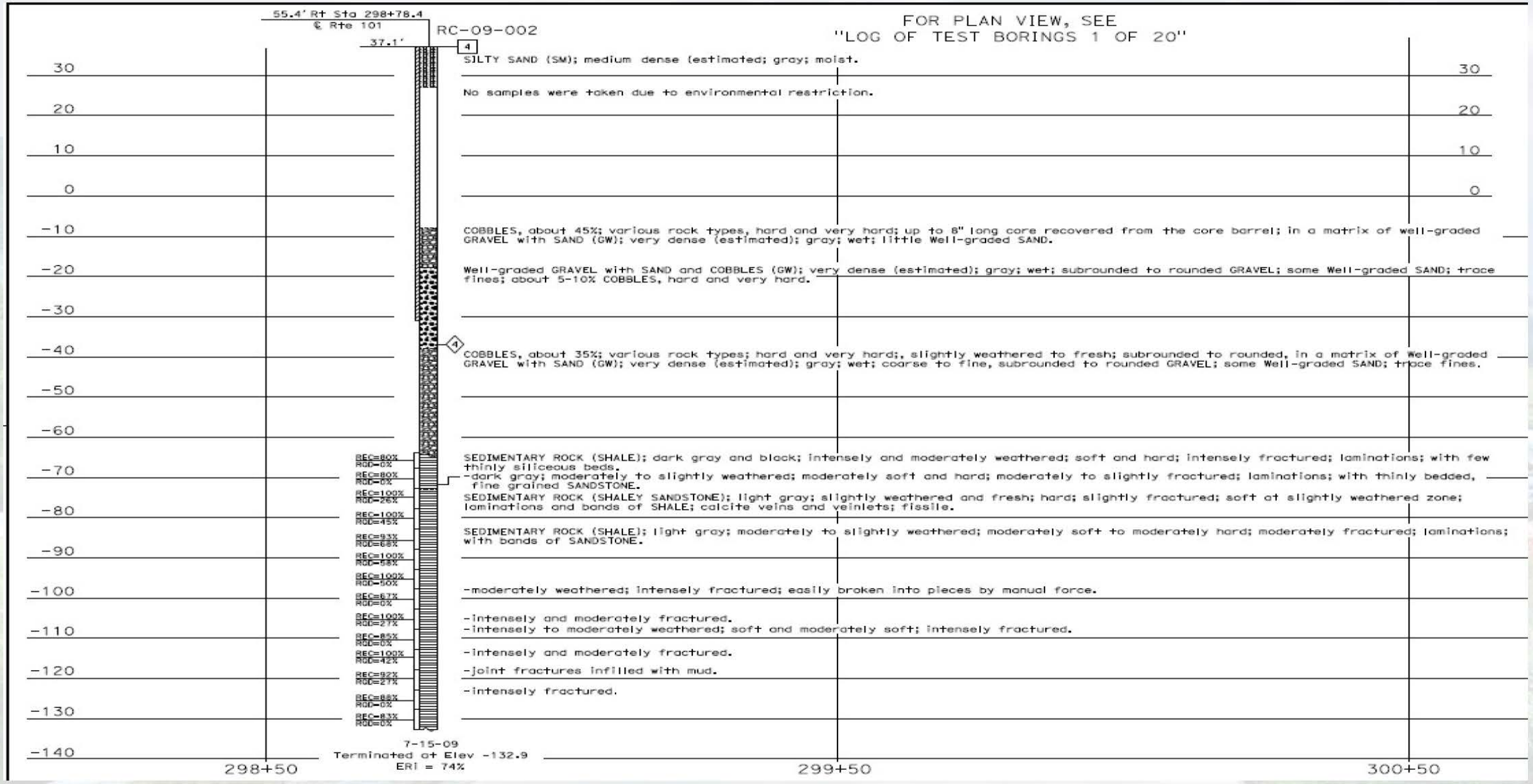
Blueprint

Design CIDH (Permanent Casing)

- 96” Ø CIDH with 108” x ½” permanent steel casing.
- Pile cut off elevation at +23.00 ft.
- Specified tip elevation at -115.00 ft.
- Steel casing specified tip elevation at -80.00 ft.
- Total steel casing length = 103 ft.
- Log of test boring.






55.4' Rt Sta 298+78.4
℄ Rte 101
37.1'
RC-09-002
FOR PLAN VIEW, SEE
"LOG OF TEST BORINGS 1 OF 20"
SILTY SAND (SM); medium dense (estimated; gray; moist.
No samples were taken due to environmental restriction.
COBBLES, about 45%; various rock types, hard and very hard; up to 8" long core recovered from the core barrel; in a matrix of well-graded GRAVEL with SAND (GW); very dense (estimated); gray; wet; little Well-graded SAND.
Well-graded GRAVEL with SAND and COBBLES (GW); very dense (estimated); gray; wet; subrounded to rounded GRAVEL; some Well-graded SAND; trace fines; about 5-10% COBBLES, hard and very hard.
COBBLES, about 35%; various rock types; hard and very hard;, slightly weathered to fresh; subrounded to rounded, in a matrix of Well-graded GRAVEL with SAND (GW); very dense (estimated); gray; wet; coarse to fine, subrounded to rounded GRAVEL; some Well-graded SAND; trace fines.
SEDIMENTARY ROCK (SHALE); dark gray and black; intensely and moderately weathered; soft and hard; intensely fractured; laminations; with few thinly siliceous beds.
-dark gray; moderately to slightly weathered; moderately soft and hard; moderately to slightly fractured; laminations; with thinly bedded, fine grained SANDSTONE.
SEDIMENTARY ROCK (SHALEY SANDSTONE); light gray; slightly weathered and fresh; hard; slightly fractured; soft at slightly weathered zone; laminations and bands of SHALE; calcite veins and veinlets; fissile.
SEDIMENTARY ROCK (SHALE); light gray; moderately to slightly weathered; moderately soft to moderately hard; moderately fractured; laminations; with bands of SANDSTONE.
-moderately weathered; intensely fractured; easily broken into pieces by manual force.
-intensely and moderately fractured.
-intensely to moderately weathered; soft and moderately soft; intensely fractured.
-intensely and moderately fractured.
-joint fractures infilled with mud.
-intensely fractured.
REC=80% RQD=0%
REC=80% RQD=0%
REC=100% RQD=26%
REC=100% RQD=45%
REC=93% RQD=68%
REC=100% RQD=58%
REC=100% RQD=50%
REC=67% RQD=0%
REC=100% RQD=27%
REC=85% RQD=0%
REC=100% RQD=42%
REC=92% RQD=27%
REC=88% RQD=0%
REC=83% RQD=0%
7-15-09
Terminated at Elev -132.9
ERI = 74%
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
298+50
299+50
300+50

Proposed Change

- The 1/2"wall likely to buckle during installation.
- Significant schedule delays.
- Use of a thicker and more robust temporary steel casing.
- Contractor's preferred means and methods.
- Incompliance with specifications.
- Eliminate the Permanent steel casing bid item from the contract.
- A no cost change order.

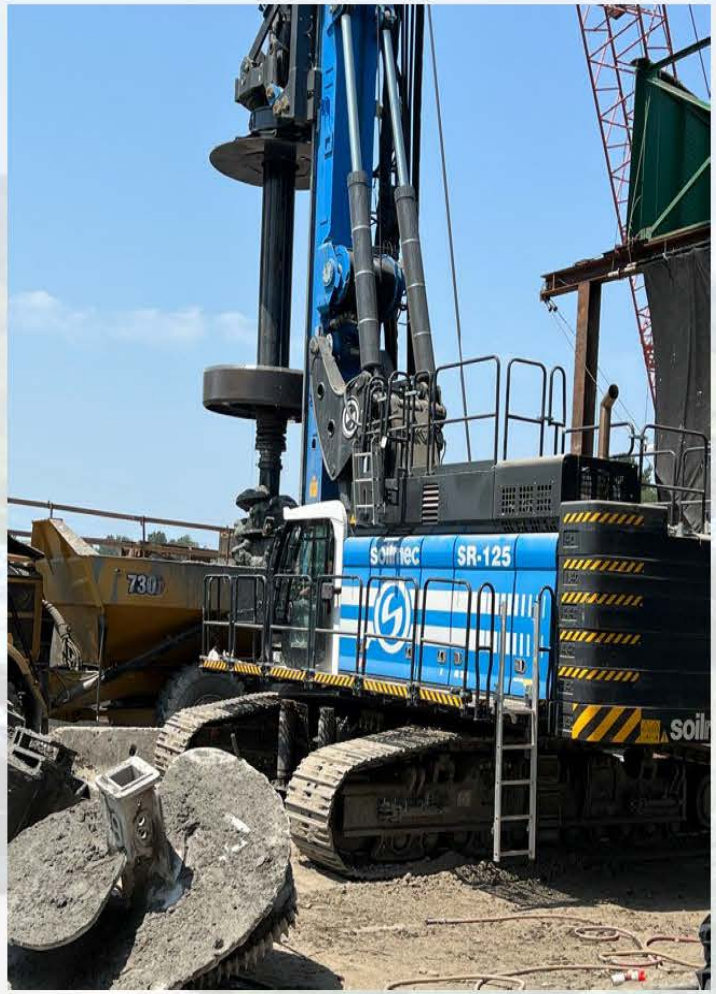
Bedrock

CIDH Installation Methodology (Temporary Casing)

- Oscillator with temporary casing (120”) to hold the hole open from caving.
- Advanced to the anticipated rock
- Drilled open hole (96”) drill rig.

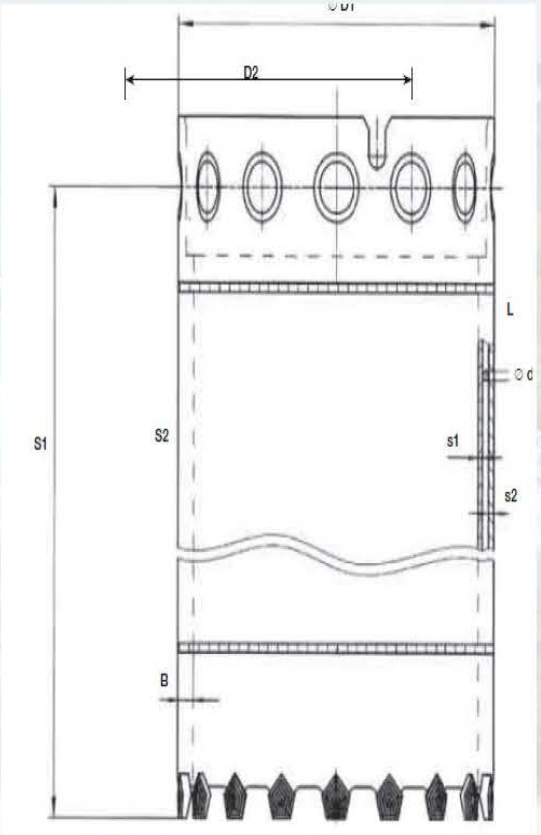
Drilling Equipment’s:

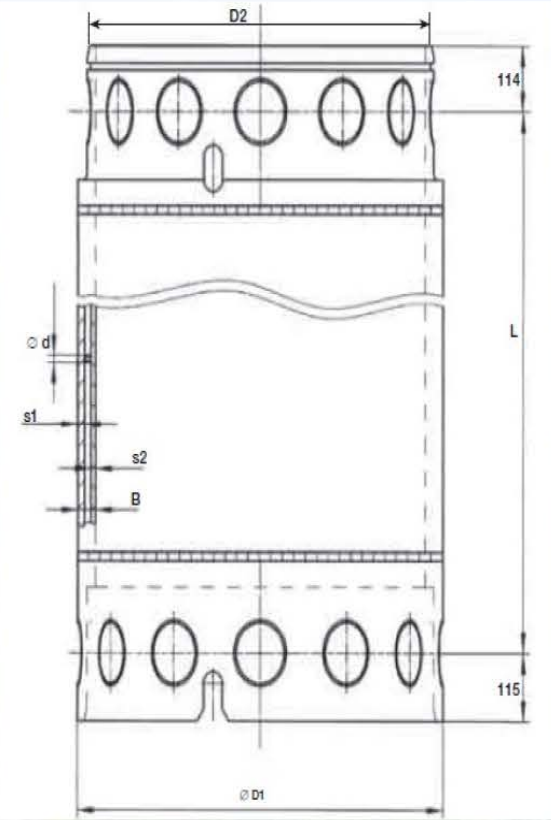
- Buma 300 Grab operated by Liebherr HS 895HD crane.
- Soilmec SR 125 rotary drilling rig.



Casing Installation

- 123” O.D casing installed to the rock layer.
- Leffer VRM 3800 casing oscillator.
- Casing sections connected by jointed segments.
- Each casing segment was about 10’ in length.
- HD bolted connections.





Drilling Sequence:

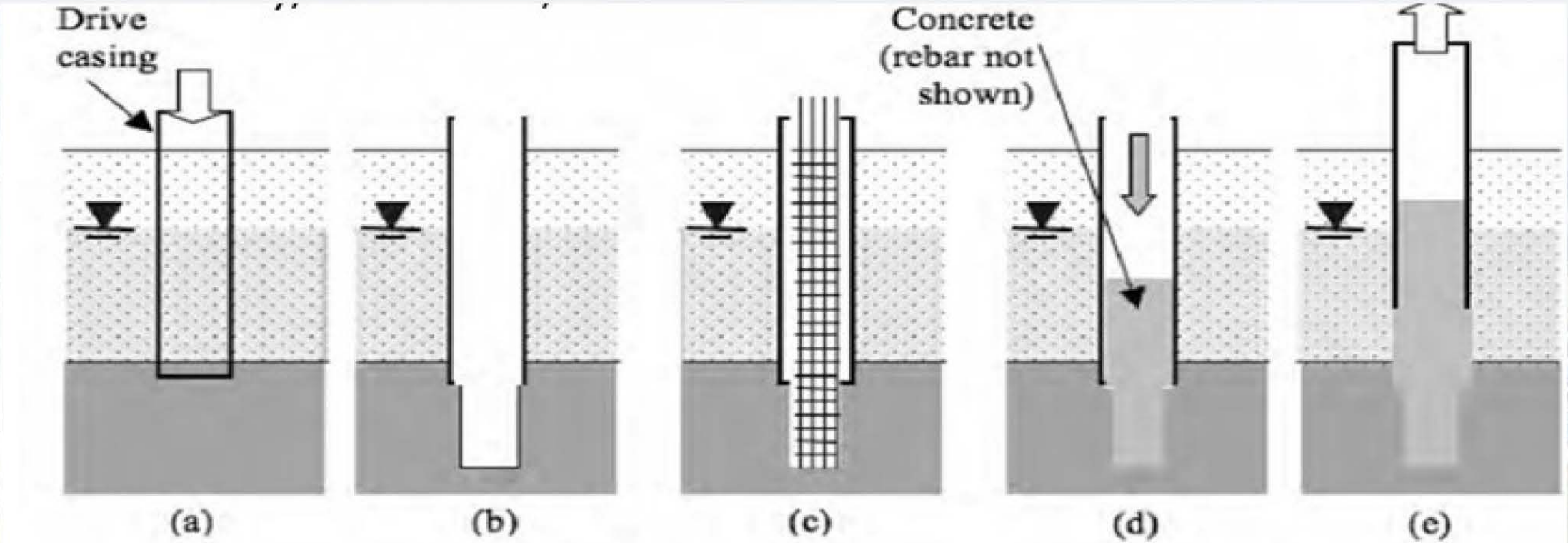


Figure 3-8 Construction Using Casing Advanced Ahead of Excavation: (a) drive casing into bearing stratum; (b) drill through casing; (c) complete and clean hole, set reinforcing; (d) place concrete to head greater than external water pressure; (e) pull casing while adding concrete

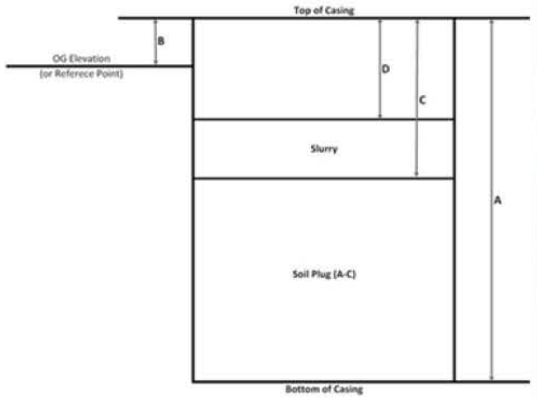
Points to be taken care of:

- Soil plug on oscillator casing
- Fluid head relative to ground water elevation
- Oscillator pressure
- Slurry test parameters

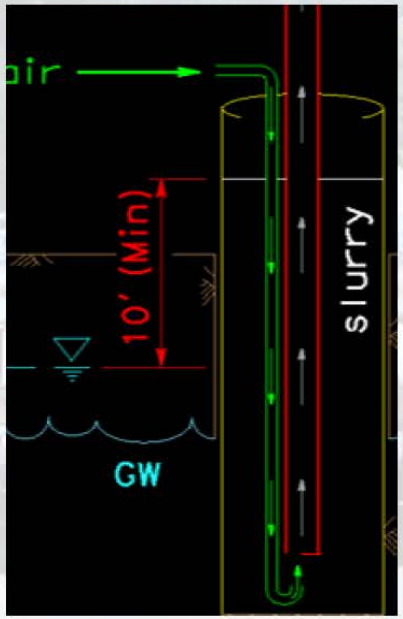
Maintaining Soil Plug

- ASR and Contractor should be measuring a logging to maintain the soil plug.

Oscillated CIDH Pile Profile Form. *NEW*

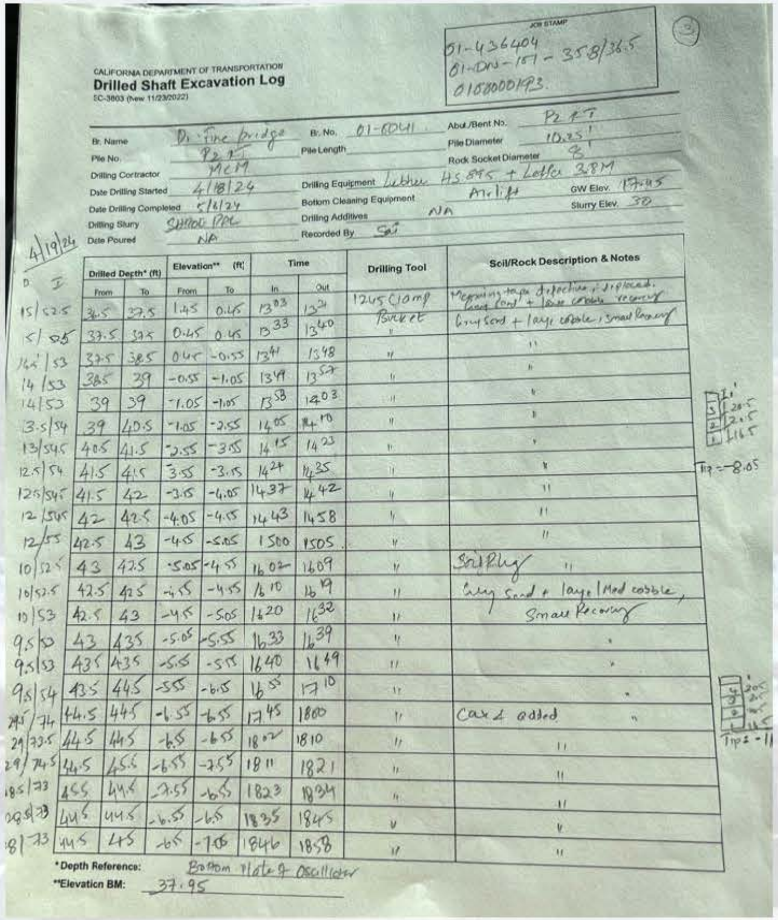


- Top of Soil Plug
- Top of Slurry
- Exposed casing
- Soil Plug Thickness
- Piezometric Head / GWS



Excavation log:

- Full time inspection
- Drilling tools used
- Drilled depth
- Elevation tip
- Soil description and notes
- Time in/out
- Casing tip established



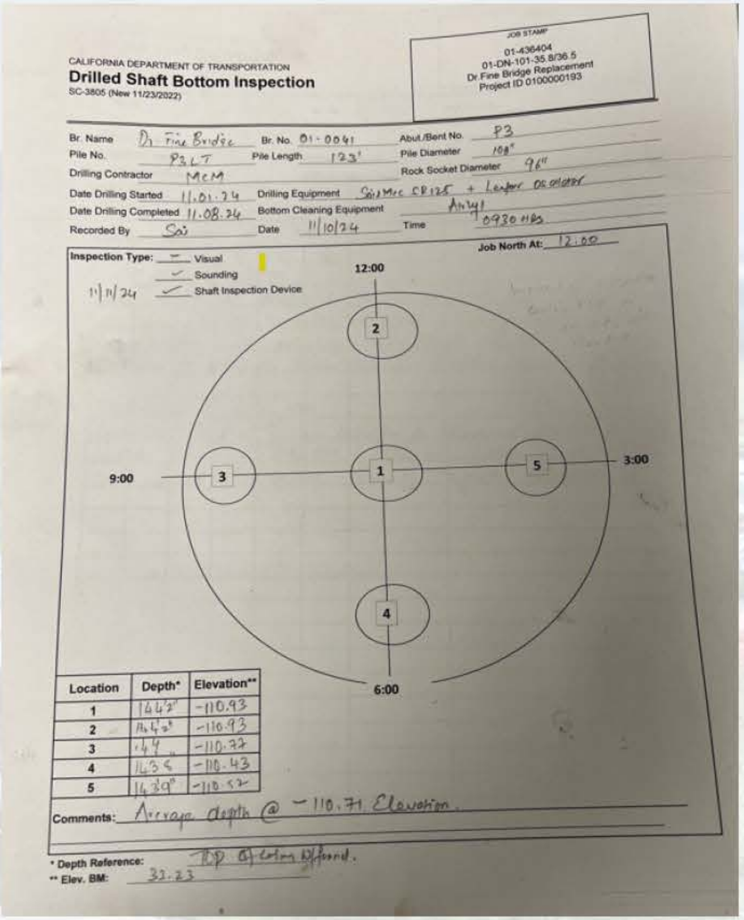
CALIFORNIA DEPARTMENT OF TRANSPORTATION
Drilled Shaft Excavation Log
SC-3803 (New 11/23/2022)

JOB STAMP: 01-436404 / 01-DN-101-35.8/36.5 / 0100000193

Br. Name: Dr. Fine Bridge — Br. No.: 01-0041 — Abut./Bent No.: P2 RT
Pile No.: P2 RT — Pile Length: — Pile Diameter: 10.25'
Drilling Contractor: McM — Rock Socket Diameter:
Date Drilling Started: 4/18/24 — Drilling Equipment: Leibherr HS 895 + Leffer 38M
Date Drilling Completed: 5/1/24 — Bottom Cleaning Equipment: Airlift — GW Elev.: 17.45
Drilling Slurry: Shore Pac — Drilling Additives: NA — Slurry Elev.: 30
Date Poured: NA — Recorded By: Sai

Drilled Depth* (ft) From	To	Elevation** (ft) From	To	Time In	Out	Drilling Tool	Soil/Rock Description & Notes
36.5	37.5	1.45	0.45	1303	1321	1245 Clamp	[illegible]
37.5	37.5	0.45	0.45	1333	1340	Bucket	Gray Sand + layer cobble, Small Recovery
37.5	38.5	0.45	-0.55	1341	1348	"	"
38.5	39	-0.55	-1.05	1349	1357	"	"
39	39	-1.05	-1.05	1358	1403	"	"
39	40.5	-1.05	-2.55	1405	1410	"	"
40.5	41.5	-2.55	-3.55	1415	1423	"	"
41.5	41.5	-3.55	-3.55	1424	1435	"	"
41.5	42	-3.55	-4.05	1437	1442	"	"
42	42.5	-4.05	-4.55	1443	1458	"	"
42.5	43	-4.55	-5.05	1500	1505	"	"
43	42.5	-5.05	-4.55	1602	1609	"	Stirring
42.5	42.5	-4.55	-4.55	1610	1619	"	Gray Sand + layer Med cobble, Small Recovery
42.5	43	-4.55	-5.05	1620	1632	"	
43	43.5	-5.05	-5.55	1633	1639	"	"
43.5	43.5	-5.55	-5.55	1640	1649	"	"
43.5	44.5	-5.55	-6.55	1655	1710	"	"
44.5	44.5	-6.55	-6.55	1745	1800	"	Casing added
44.5	44.5	-6.55	-6.55	1802	1810	"	"
44.5	45.5	-6.55	-7.55	1811	1821	"	"
45.5	44.5	-7.55	-6.55	1823	1834	"	"
44.5	44.5	-6.55	-6.55	1835	1845	"	"
44.5	45	-6.55	-7.05	1846	1858	"	"

*Depth Reference: Bottom Plate of Oscillator
**Elevation BM: 37.95



CALIFORNIA DEPARTMENT OF TRANSPORTATION
Drilled Shaft Bottom Inspection
SC-3805 (New 11/23/2022)

JOB STAMP: 01-436404 / 01-DN-101-35.8/36.5 / Dr.Fine Bridge Replacement / Project ID 0100000193

Br. Name: Dr. Fine Bridge — Br. No.: 01-0041 — Abut/Bent No.: P3
Pile No.: P3 LT — Pile Length: 123' — Pile Diameter: 108"
Drilling Contractor: McM — Rock Socket Diameter: 96"
Date Drilling Started: 11.01.24 — Drilling Equipment: SoilMec CR125 + Leffer Oscillator
Date Drilling Completed: 11.08.24 — Bottom Cleaning Equipment: Airlift
Recorded By: Sai — Date: 11/10/24 — Time: 0930 hrs
Job North At: 12:00

Inspection Type: Visual / Sounding / Shaft Inspection Device

Location	Depth*	Elevation**
1	144.2'	-110.93
2	144.2'	-110.93
3	144'	-110.77
4	143.6	-110.43
5	143.9'	-110.52

Comments: Average depth @ -110.71 Elevation.

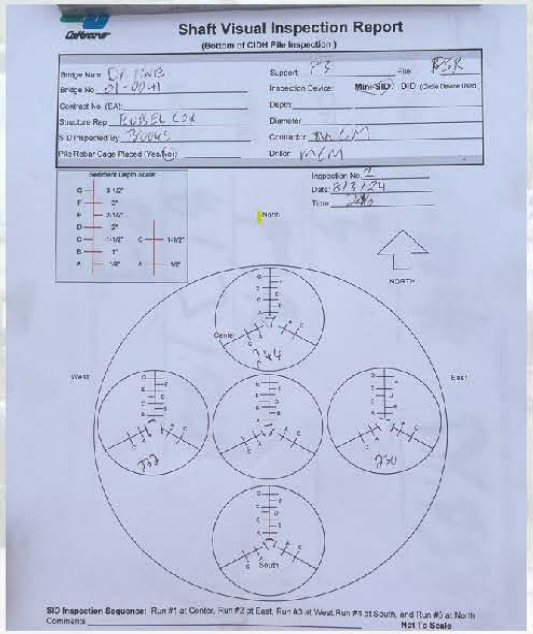
* Depth Reference: Top of Casing w/ board.
** Elev. BM: 33.23

Verifying the hole – SID Test

- Bottom cleanliness.
- Proper bearing surface.
- SID camera system, Live video monitor.
- Measuring device.

Acceptance criteria:

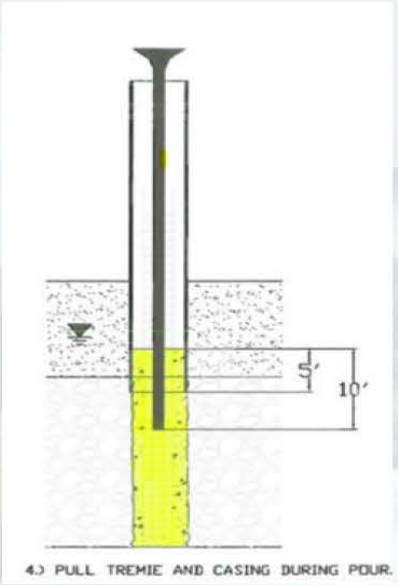
- 0.5 inch over more than 50 percent of the base.
- 1 inch at any location across the base of the shaft.
- Essential for tip resistance pile.



Rebar cage

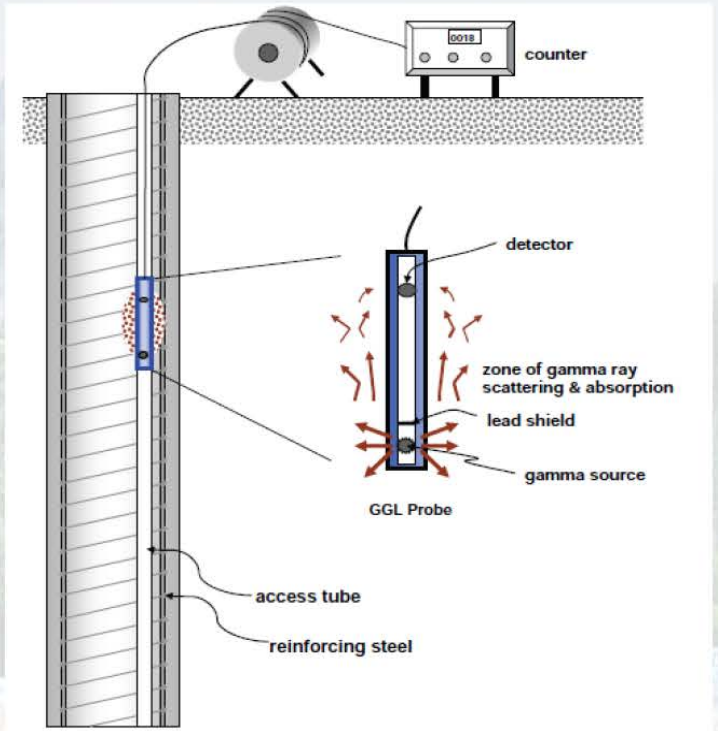
- Inspection tubes per plan installed for GGL testing
- Crane used to lift the rebar cage with slings/rigging cables for installation at the CIDH pile

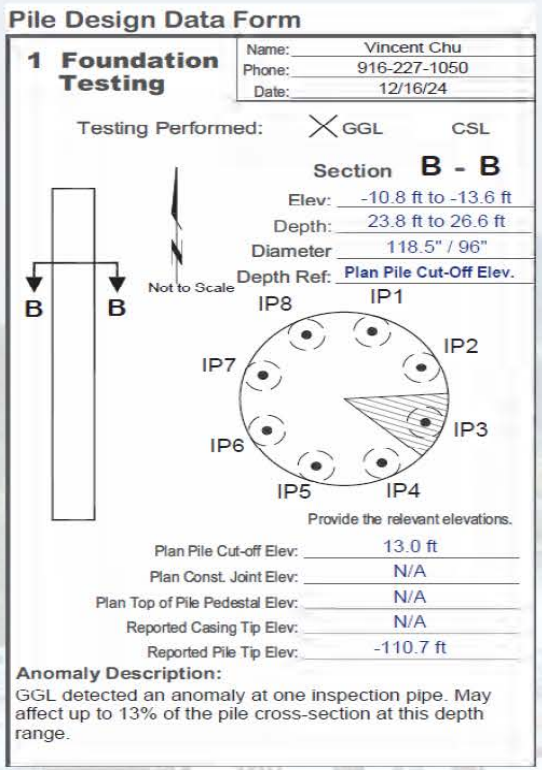
Concrete placement



- Tremie pipe raised as concrete is placed, maintaining 10’ min. concrete head.
- Placement rate including the breaks for casing removal (30 mins. 2-3 breaks and 30 min. for end clean up = total cy (361) /hr. +3*30min. +30min.= 8 hours approx.

Pile Acceptance – GGL Testing:





Pile Design Data Form

1 Foundation Testing

Name: Vincent Chu
Phone: 916-227-1050
Date: 12/16/24

Testing Performed: X GGL CSL

Section B - B

Elev: -10.8 ft to -13.6 ft
Depth: 23.8 ft to 26.6 ft
Diameter 118.5" / 96"
Depth Ref: Plan Pile Cut-Off Elev.

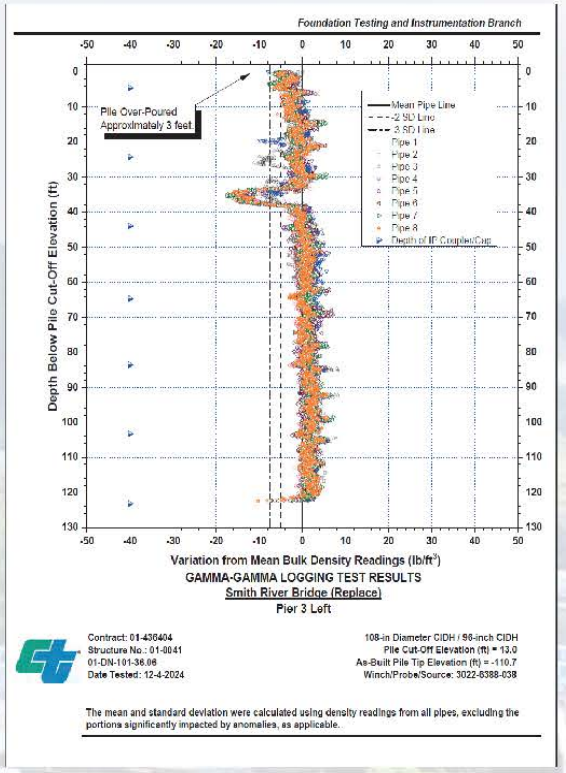
Not to Scale

IP1 IP2 IP3 IP4 IP5 IP6 IP7 IP8

Provide the relevant elevations.

Plan Pile Cut-off Elev: 13.0 ft
Plan Const. Joint Elev: N/A
Plan Top of Pile Pedestal Elev: N/A
Reported Casing Tip Elev: N/A
Reported Pile Tip Elev: -110.7 ft

Anomaly Description:
GGL detected an anomaly at one inspection pipe. May affect up to 13% of the pile cross-section at this depth range.



- NDT test method.
- Nuclear density probe
- Concrete density vs pile depth for homogeneity.
- Electric wench pulls a 4-foot probe through the tubes.

Permanent vs Temporary casing : A comparison

Aspect	Temporary Casing	Permanent Casing
Material Handling	Reusable	One time
Installation	Standard construction practice	Precision placement
Repair risk	Low	High
Performance	No corrosion concerns	Corrosion risk
Side resistance	Can be considered	Usually not considered
Design	Concrete	Composite
Schedule impact	Faster	Slower

Results & Significance

- The need for permanent casing was eliminated.
- Eliminated the need for pump grout and grout tubes that fill the voids in the annular space between the casing and the soil.
- Temporary casing is more practical and flexible for construction.
- Cost savings in material procurement and fabrication.
- No impact on controlling activities or critical path items.
- Concrete placed under its own pressure head against the gravel irregular soil face produce a far better skin friction, as compared to the steel against soil pile.

Conclusion:

- Total cost savings for the proposed change were $45,676.36
- Construction efficiency and cost effectiveness were improved.
- Inspection and quality control were more straightforward.
- Design considerations were satisfactorily met.
- Overall project risk was reduced.

For sites where excavation support is required only during construction, temporary steel casing provides superior construction efficiency and lower life-cycle risk compared to permanent casing.

Thank you