

Stabilizing the Devil Slide with Hollow Core, Grout Injection Bored (IBO®) Micro Piles For Caltrans

**Horst Aschenbroich, Con-Tech Systems Ltd,
Delta BC, Canada**



**Titan
Hollow Bar**

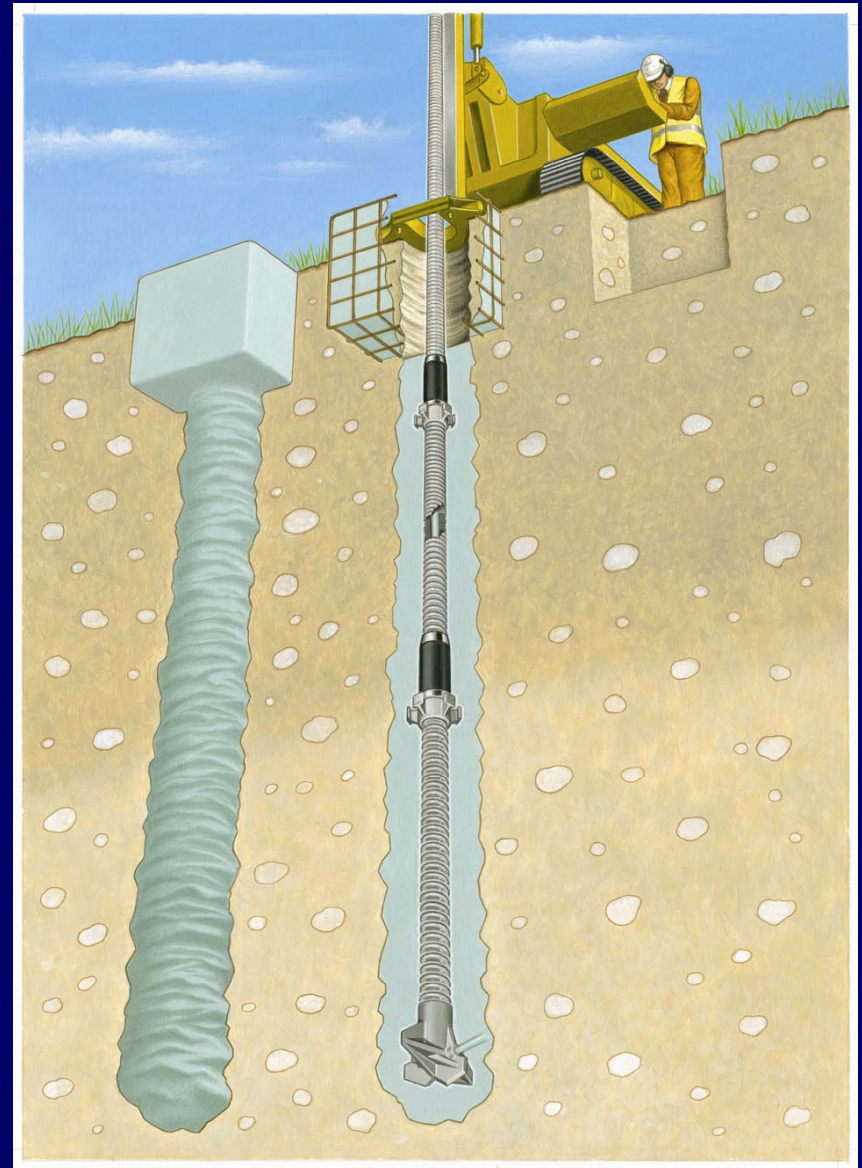
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The use of Grout Injection Bored, (IBO®) hollow bars for micro piles has increased rapidly over the past 10 years. These Micro Piles are different from others.



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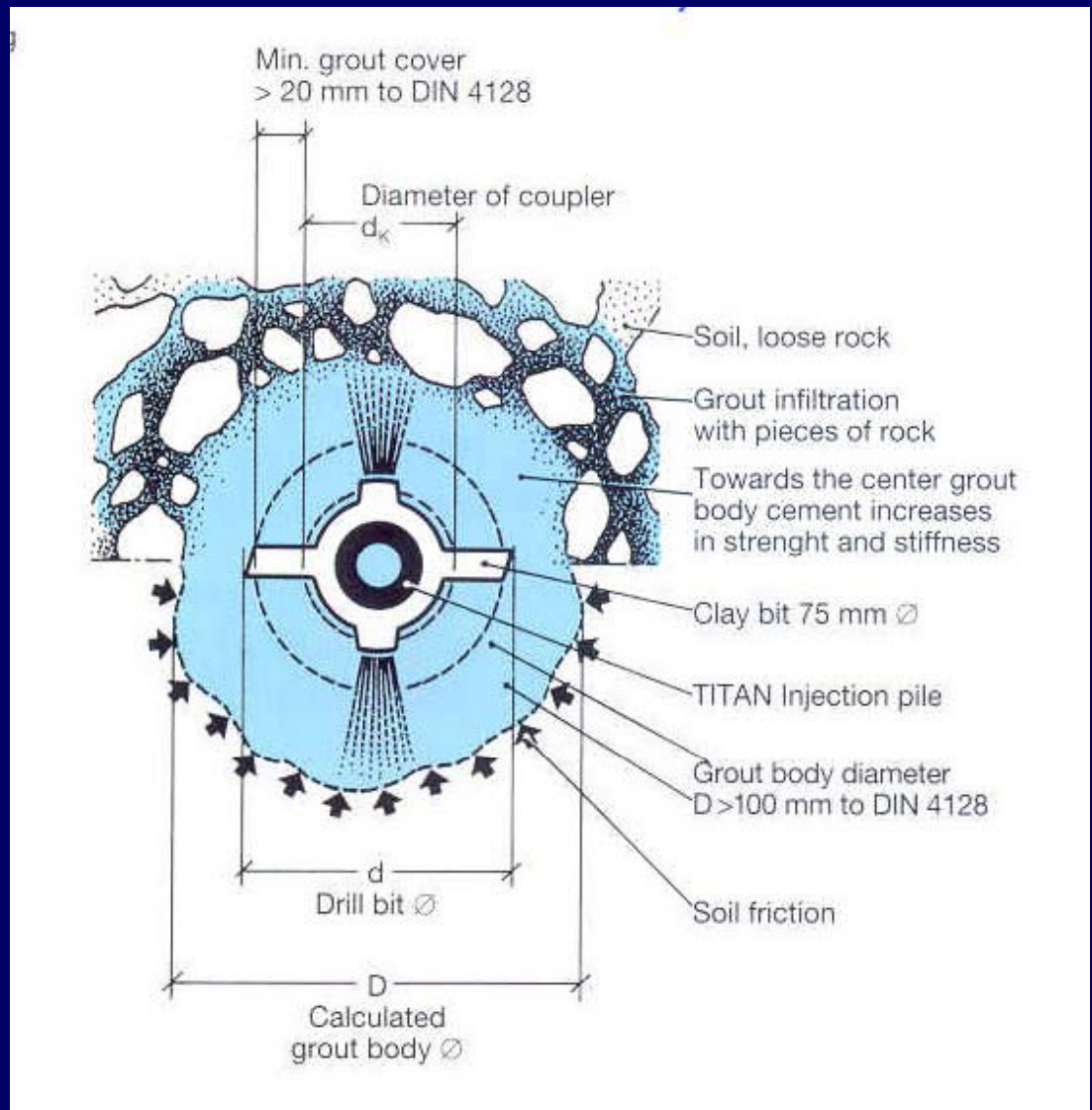
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CON-TECH

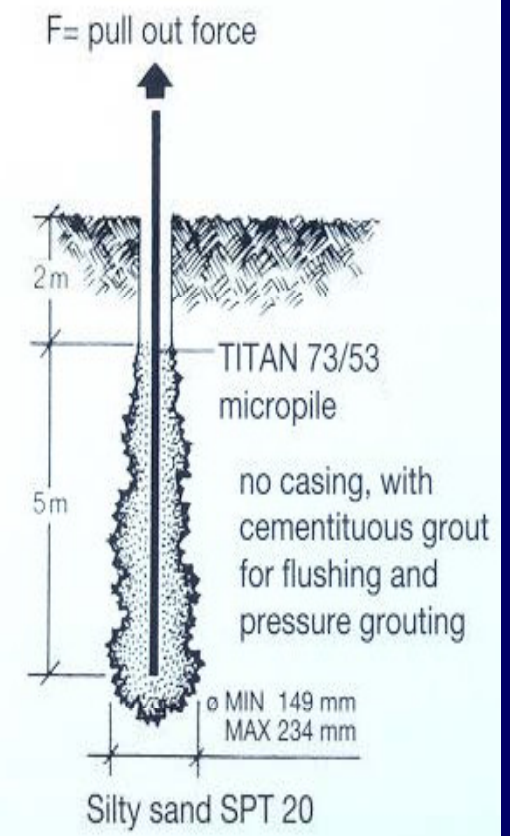
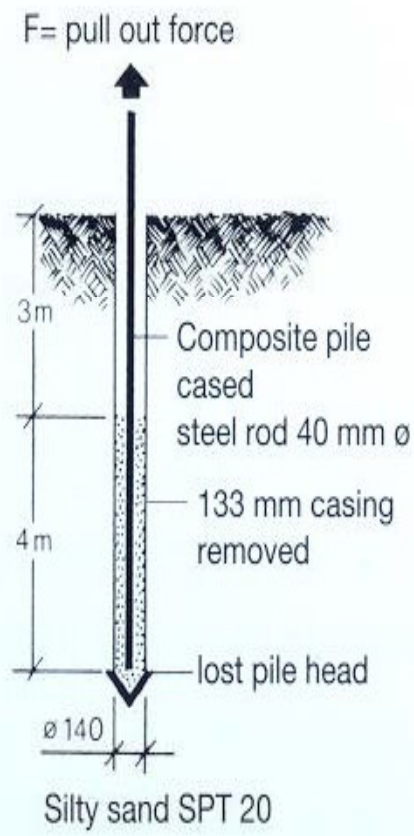
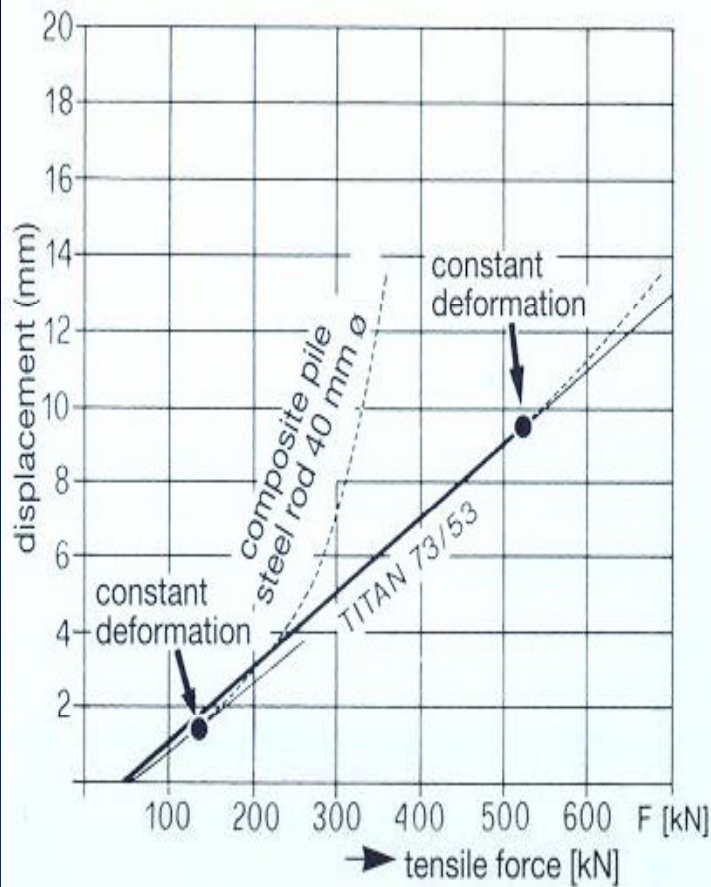
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With the dynamic rotary grout flushing during drilling, the surrounding ground is vastly improved and very high grout to ground bond-friction is achieved to resist difficult loading conditions.



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The Grout to Ground Friction

is equal or higher than open hole ore casing drilled and post-grouted Micropiles



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The Project consists of two parts:

1. The Devil Slide Emergency Repair
2. South Tunnel Portal Retaining Wall Support,
Both near each other on the Pacific Coastal
Highway #1 in California.

Owner: Caltrans

Contractors: Drill Tech and Condon Johnson

This is a typical case history where hollow bar micro piles have been chosen to stabilize a landslide for Caltrans, to resist a very difficult loading condition which constantly triggered the slides at this location.



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First project,

The Devil Slide Emergency Repair



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The Beautiful Coast Line in California But If ??

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For many years, just north of Half Moon Bay on the Pacific Coast Highway (PCH), landslides similar to this one caused many traffic delays along this stretch of road called Devil Slide.



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Millions of dollars have been spent in the past, trying to rectify this problem with a variety of slope stabilization methods, all with little or no success.

The PCH is a heavily traveled road, not only by tourists but also by many coastal residences and businesses. It was therefore decided to bypass this part of the highway.

The solution to solve the problem

Building a combination tunnel and bridge through the mountain and over the valley north of the tunnel.



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**Caltrans had used Hollow Bar Micro piles
for previous projects**

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**The decision was made
to specify Titan Hollow bars also
for this project,**



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**Failing, existing shotcrete slope repaired
with Titan 40/20 IBO® Rock Anchors**



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**Had to be drilled from a Cage to provide
ground improvement for global Tie Back
Anchors**

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Sufficient working space allowed installation of the Tie Back Anchors at the southern end of the slide

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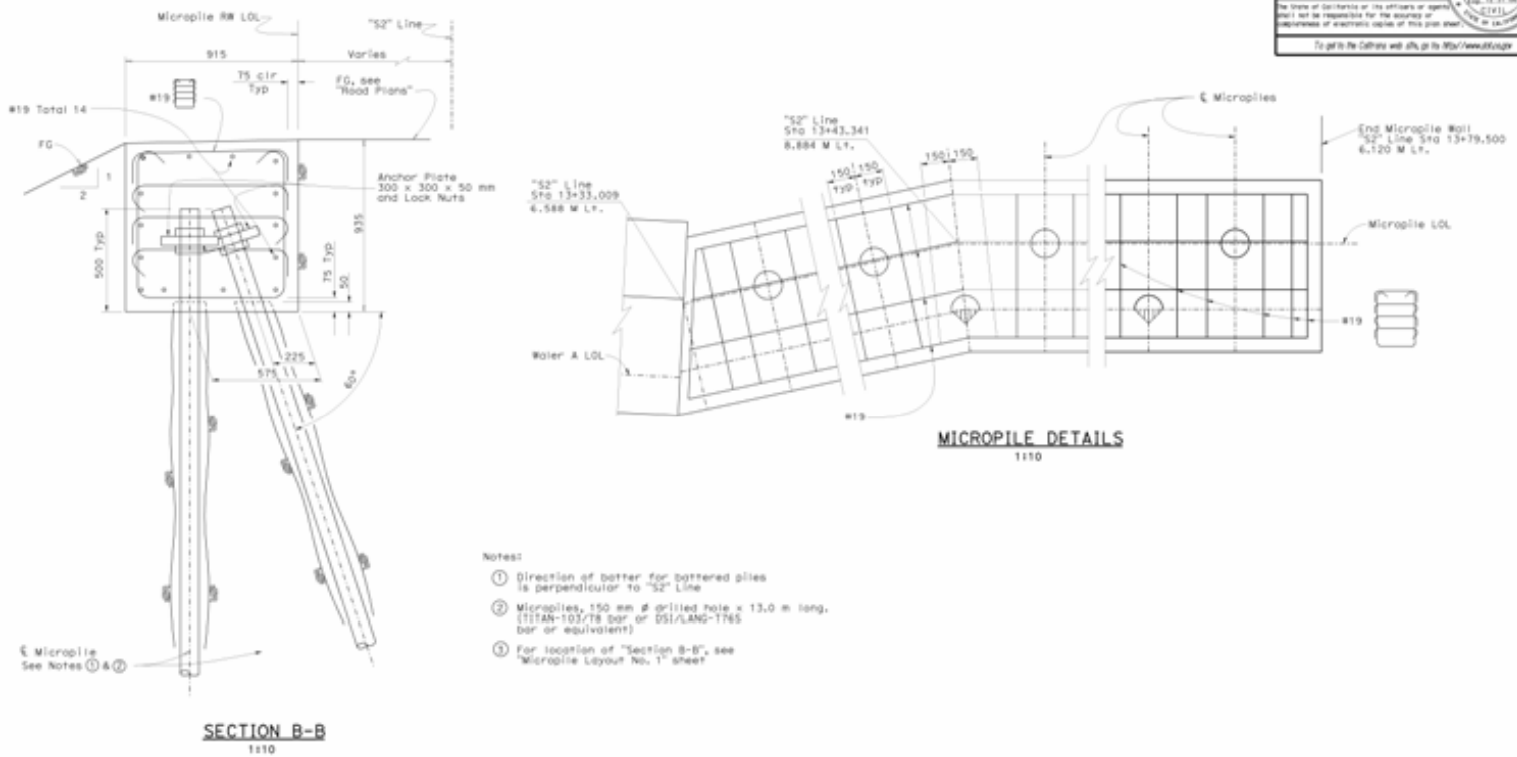
DATE	COUNTY	ROUTE	SECTION	PROJECT NO.	SHEET NO.
04	SM	1			

REGISTERED CIVIL ENGINEER "DATE"

PLANS APPROVAL DATE

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To go to the Caltrans web site go to: <http://www.dot.ca.gov>



- Notes:
- Direction of batter for battered piles is perpendicular to "S2" Line
 - Micropiles, 150 mm ϕ drilled hole x 13.0 m long. (TITAN-103/78 30" or OSI/LANG-1765 bar or equivalent)
 - For location of "Section B-B", see "Micropile Layout No. 1" sheet

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

	DESIGN	BY P. Lopez	CHECKED P. Norbow	PROJECT NO.	360-0026	DEVIL'S SLIDE BUTTRESS MICROPILE TYPICAL SECTION								
	DETAILS	BY P. Lopez	CHECKED P. Norbow	DATE	7/9.1									
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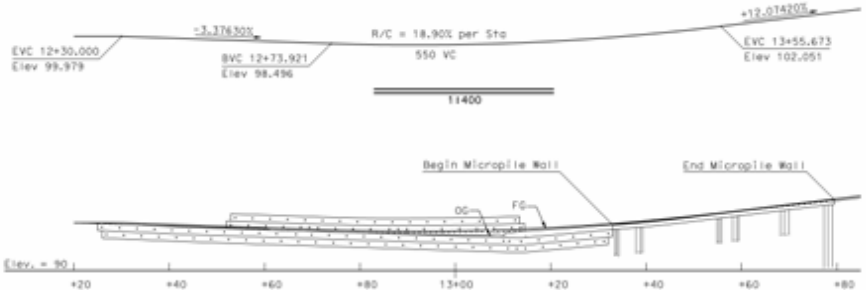


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Micropile detail for the northern end of the slide,

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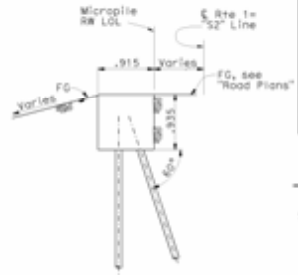


WALER LOCATION

Water	Begin Station	End Station
A	12+25.000	13+32.970
B	12+25.915	13+32.055
C	12+52.000	13+14.545
D	12+52.915	13+13.305

DEVELOPED MIRROR ELEVATION
11400

Notes:
1. Not all Water formed holes shown
2. Not all Micropiles shown



MICROPILE WALL TYPICAL SECTION
1140

DIST	COUNTY	ROUTE	SECTION	TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	SM	1				

REGISTERED CIVIL ENGINEER DATE: 11/19/04
 PHILIP S. LUFF
 SMR
 Exp. 12/31/05
 CIVIL
 Exp. 07/01/06

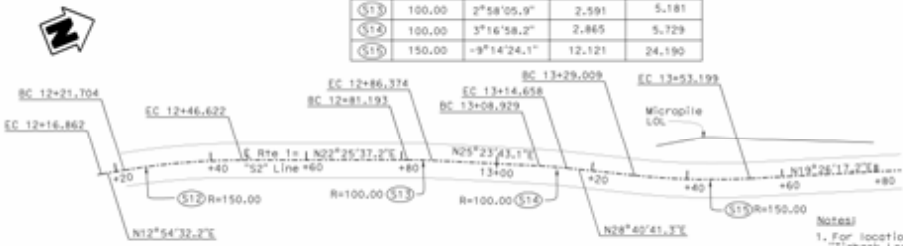
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INDEX TO PLANS

- SHEET NO. TITLE
1. GENERAL PLAN
 2. TYPICAL SECTION
 3. WALER TIEBACKS
 4. CONCRETE WALER DETAILS NO. 1
 5. TIEBACK TENDON DETAILS
 6. ROCK ANCHORS
 7. MICROPILE LAYOUT NO. 1
 8. MICROPILE LAYOUT NO. 2
 9. MICROPILE TYPICAL SECTION

CURVE DATA

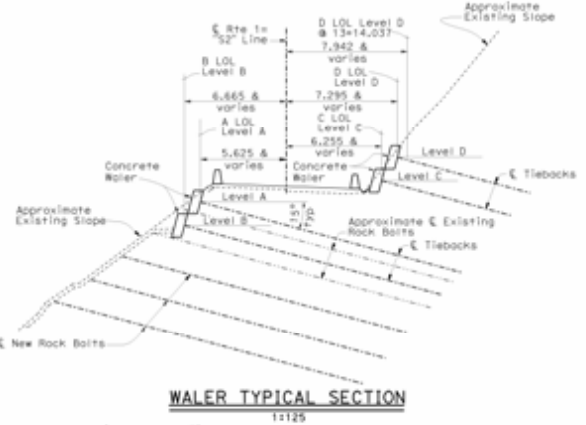
NO.	R	Δ	T	L
(ST2)	150.00	9°31'05.0"	12.488	24.918
(ST3)	100.00	2°58'05.9"	2.591	5.181
(ST4)	100.00	3°16'58.2"	2.865	5.729
(ST5)	150.00	-9°14'24.1"	12.121	24.190



PLAN
11400

NOTE:
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Notes:
1. For location, offset and elevation of Water Tiebacks, see "Tieback Location" table on "Water Tieback" sheet
2. Water LOL lines not shown
3. For station and offset of Micropile LOL, see "Micropile Layout No. 1" or "Micropile Layout No. 2" sheets



WALER TYPICAL SECTION
11225

	DESIGN	BY	DATE	APP. ENGINEER	DATE	DESIGN	DATE	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH 9	PROJECT NO. 36E0026	DEVIL'S SLIDE BUTTRESS GENERAL PLAN
	DETAILS	BY	DATE	APP. ENGINEER	DATE	DESIGN	DATE	CLU OR E.A. 021003	PROJECT BRANCH 9	DATE 11/19/04	
ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN											



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The Caltrans Design

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Drilling Micropiles from road level Limited Access

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Vertical and battered micro piles



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High Speed High Shear Grout Mixer and Holding Tank



For continuous grouting during drilling



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Forming pile cap and grade beam



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Placing Reinforcing steel in Pile Cap

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Finished emergency Slide Repair

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**Because of the fast installation
of Hollow Bar Micro Piles,
Caltrans could re-open the
Pacific Coastal Highway
ahead of schedule.**



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Second Project

**South Tunnel Portal Retaining Wall
Support and Slope Stabilization
for a detour road to start work on the
tunnel portal**



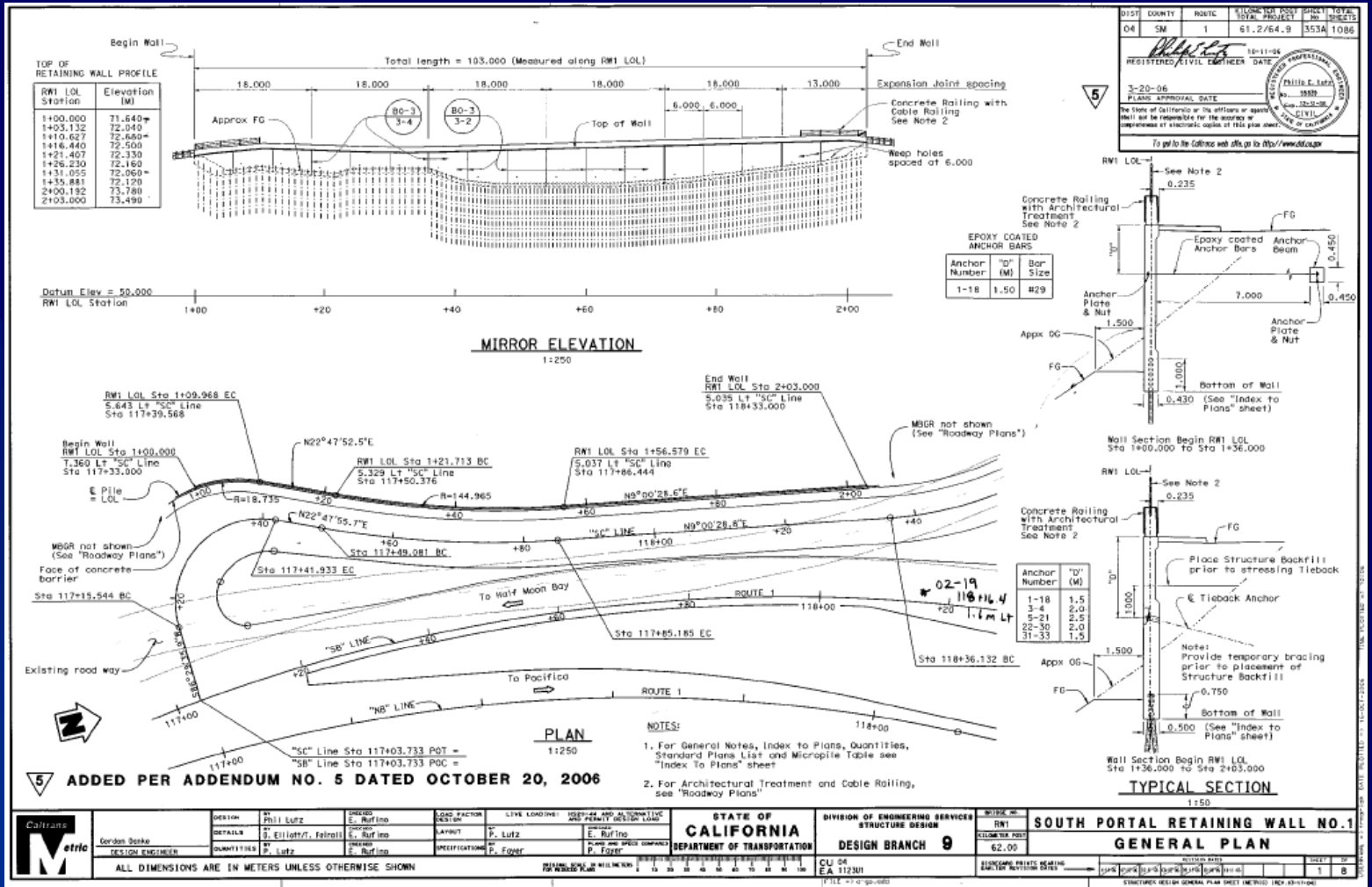
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Over 140 straight and battered Micro Piles to support the new retaining Wall and to stabilize the slope below

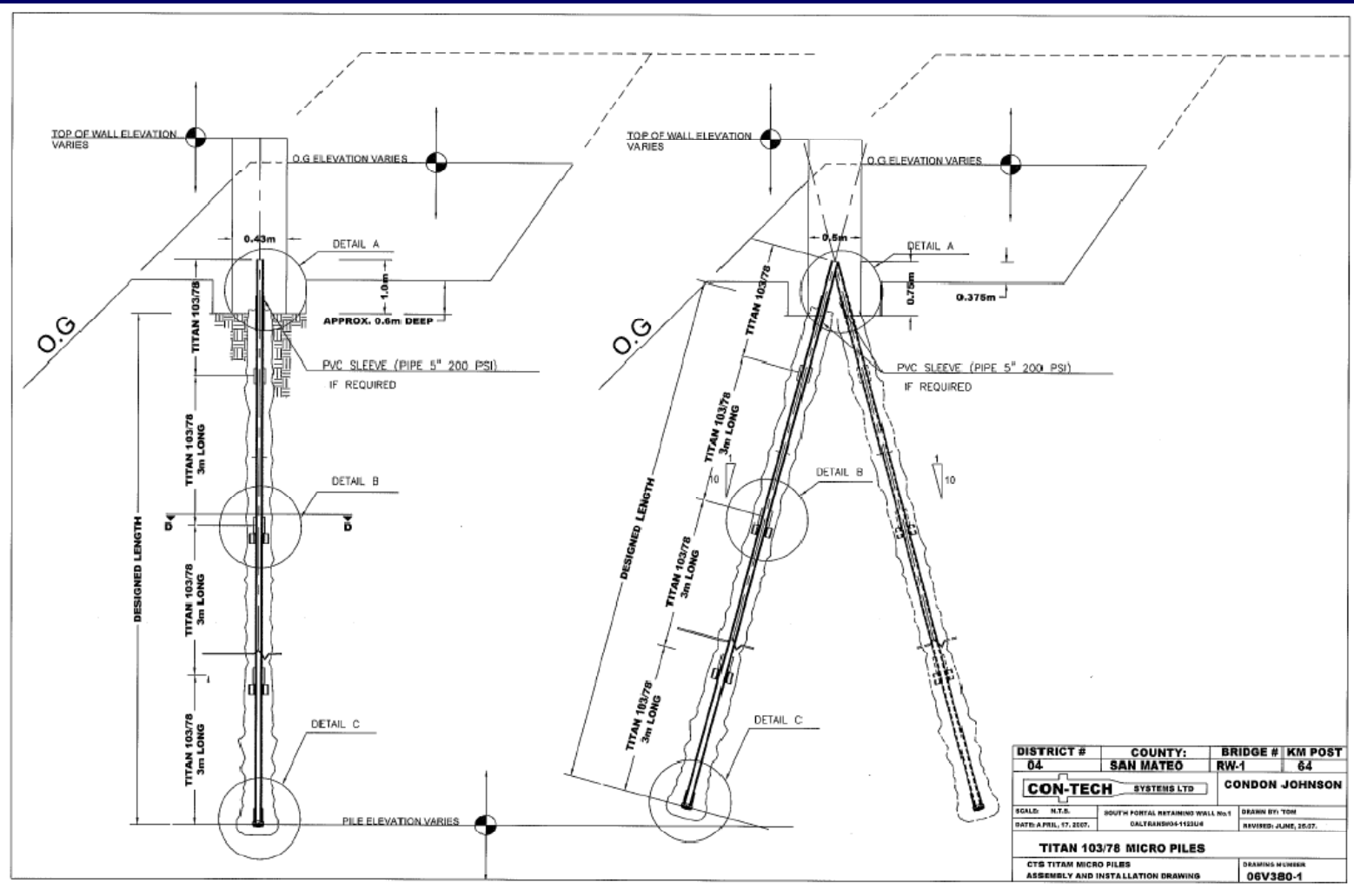
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Vertical Piles under shallow wall Battered Piles under higher wall

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Drilling vertical piles

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Trench to collect flushing grout



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difference between flushing and final grout

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Exposed excellent ground improvement



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Compression Test using production piles as reaction piles



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Piles are overlapping into wall by 1.0 m

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Forming of retaining wall

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Road is re-aligned

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The finished wall

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Tunnel construction can now start

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Thank you for your Attention



Another Landslide Near Laguna Beach, CA.

Stabilized with hollow bar passive Anchor Piles



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Massive Landslide

17 houses
lost



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Temporary support of remaining houses

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IBO Drilling of Hollow Titan 103 Bars



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Bottom row of Anchor Piles



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Finished Hollow Bar Anchor Piles



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Embankment Stabilization for VIA Rail Near Toronto, Ontario, Canada



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