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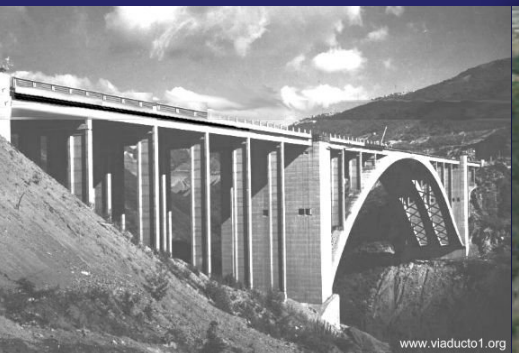
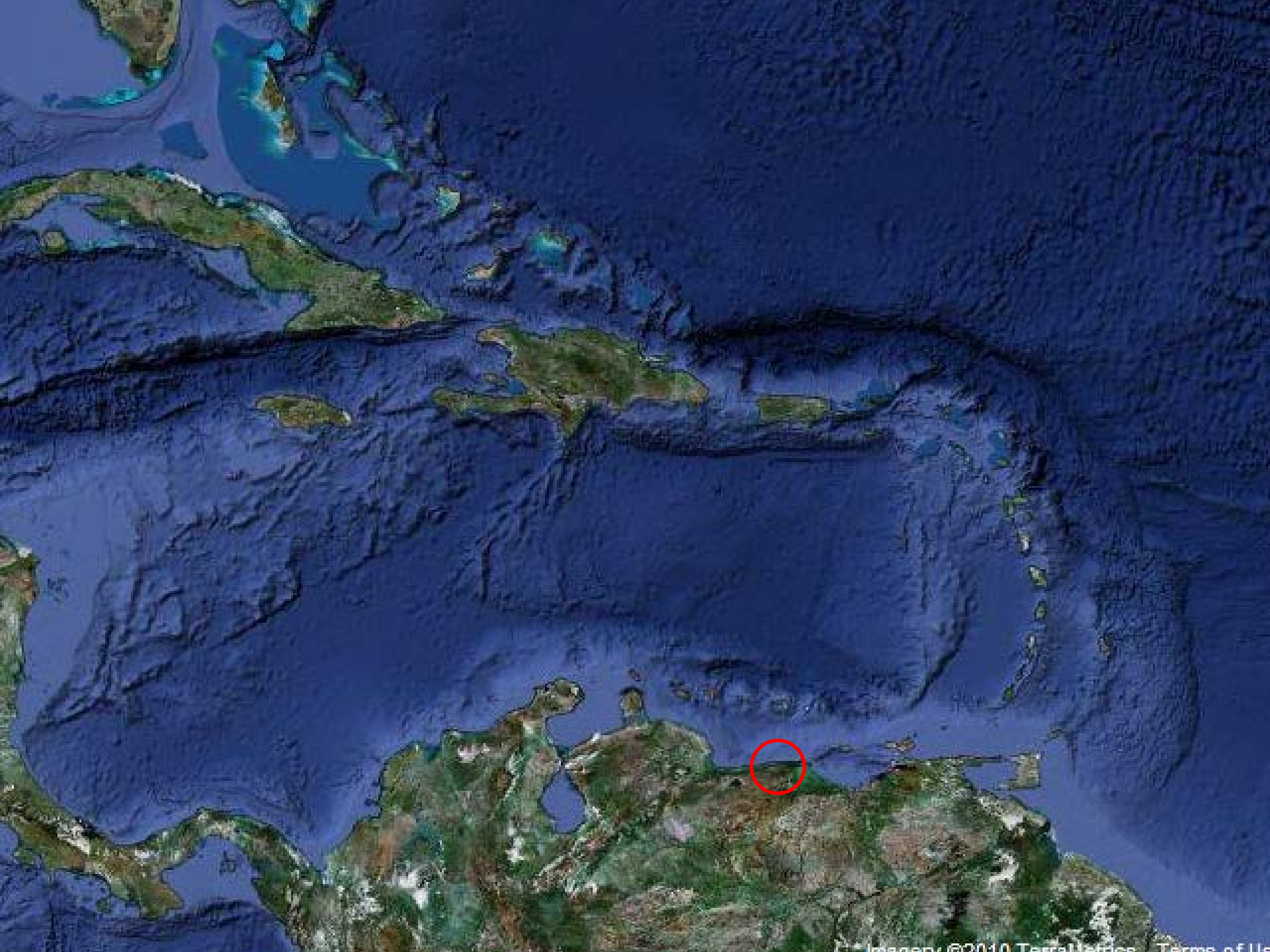
High Capacity Micropiles for Caracas-La Guaira Viaduct

Dr. Jesús Gómez, P.E., D.GE

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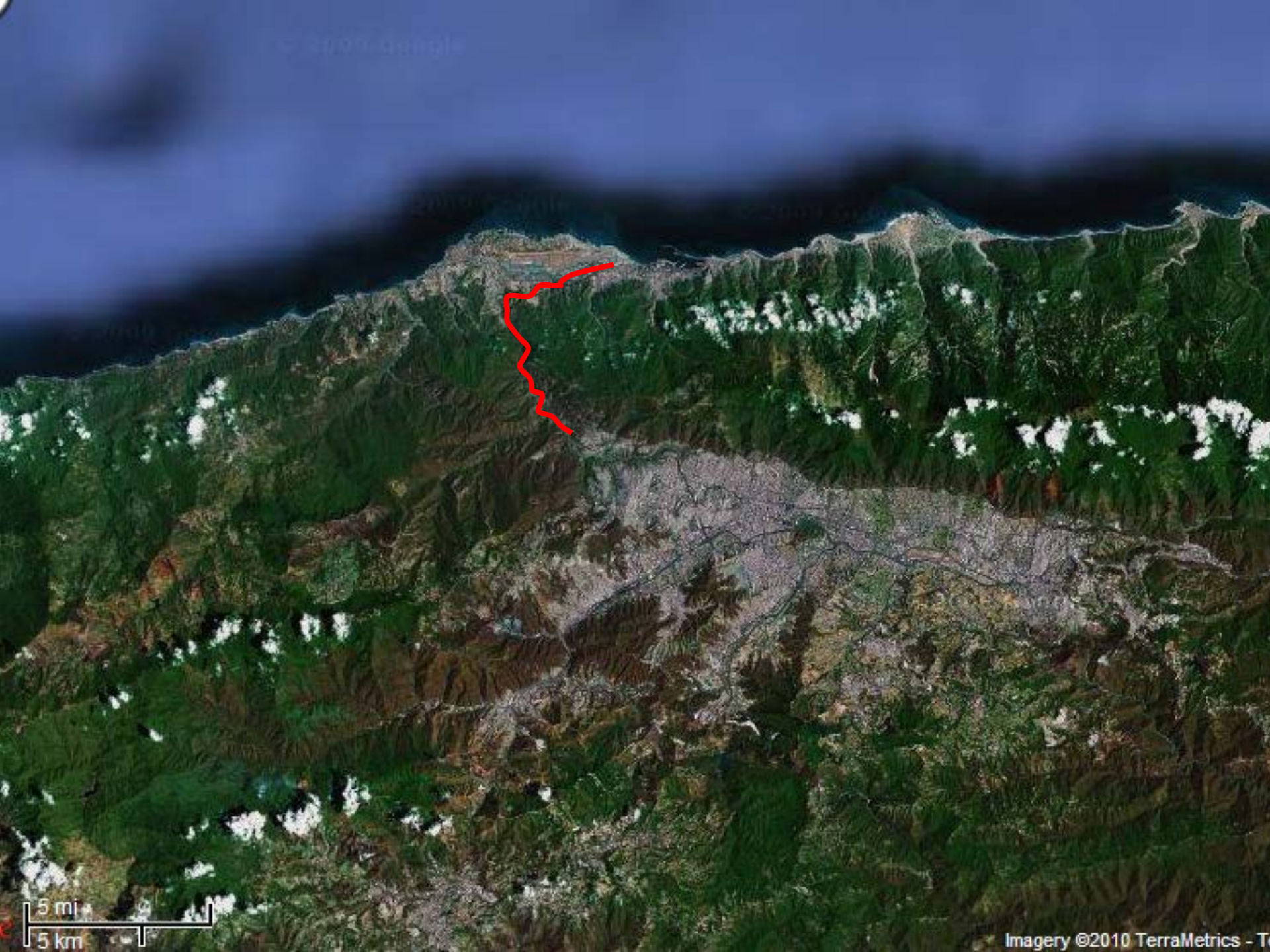
5 mi
5 km
Imagery ©2010 TerraMetrics - T


Viaducto No 1
Tacagua
1000 ft
500 m
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1000 ft
500 m
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Caracas-La Guaira Viaduct No 1

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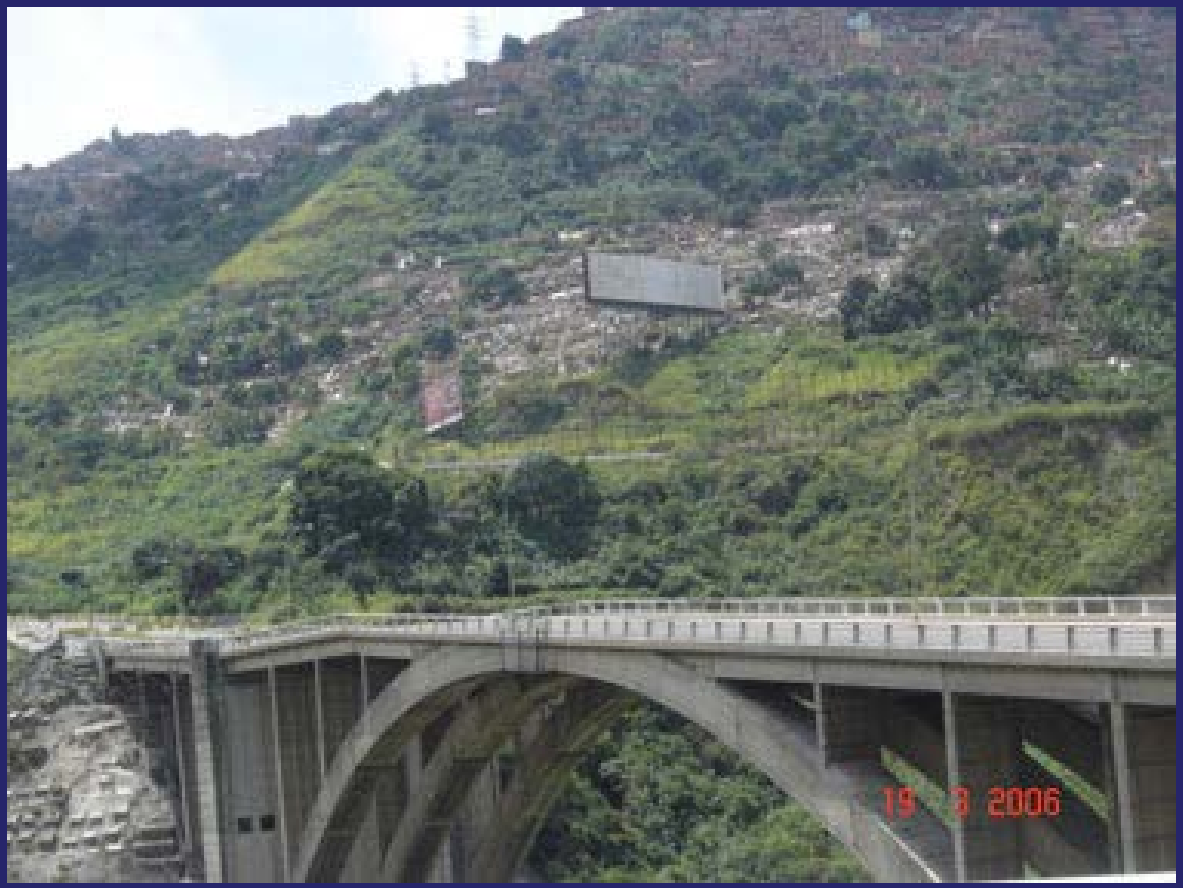
Caracas-La Guaira Viaduct No 1



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Caracas-La Guaira Viaduct No 1

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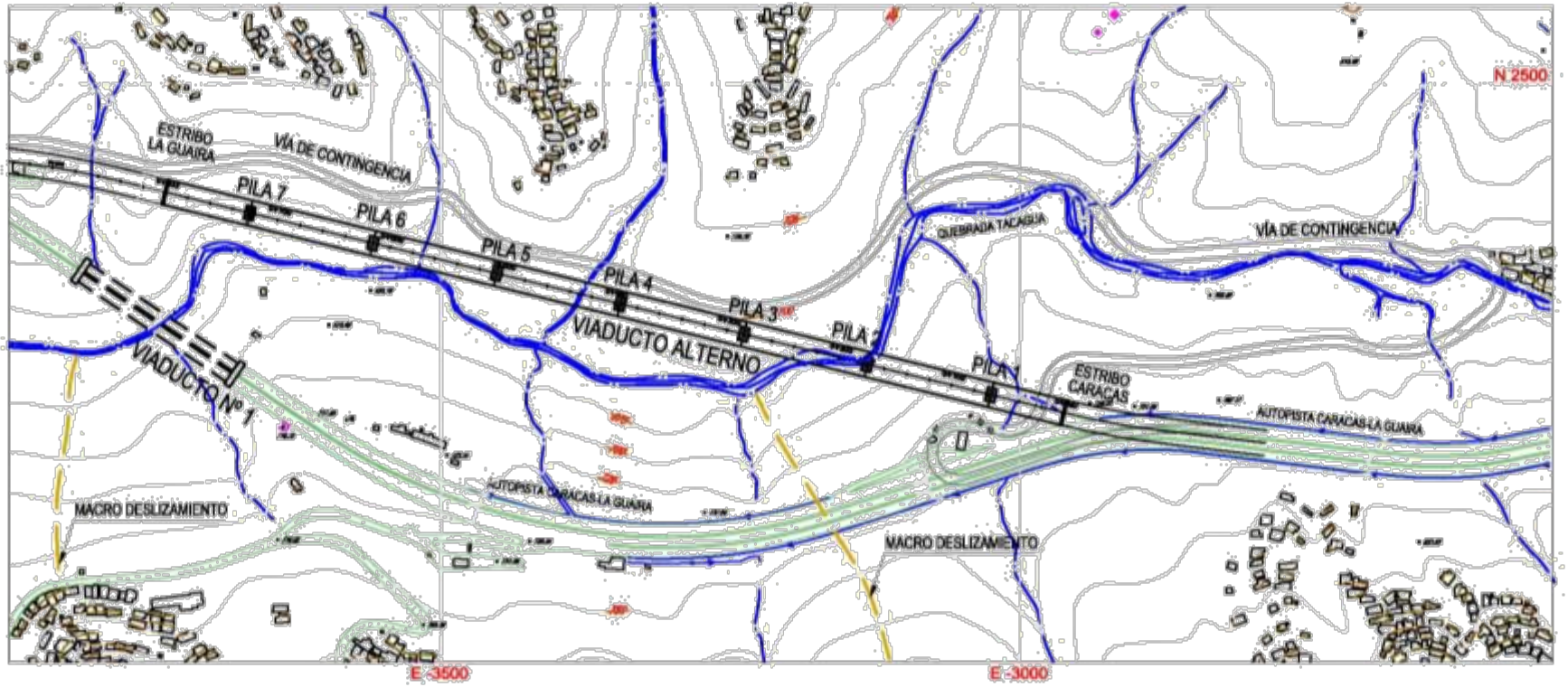
New Viaduct



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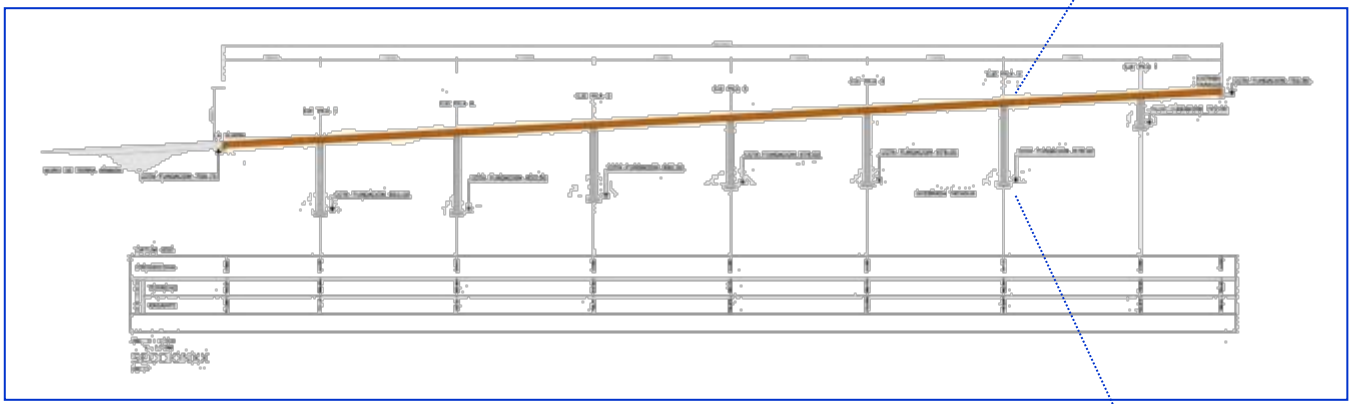
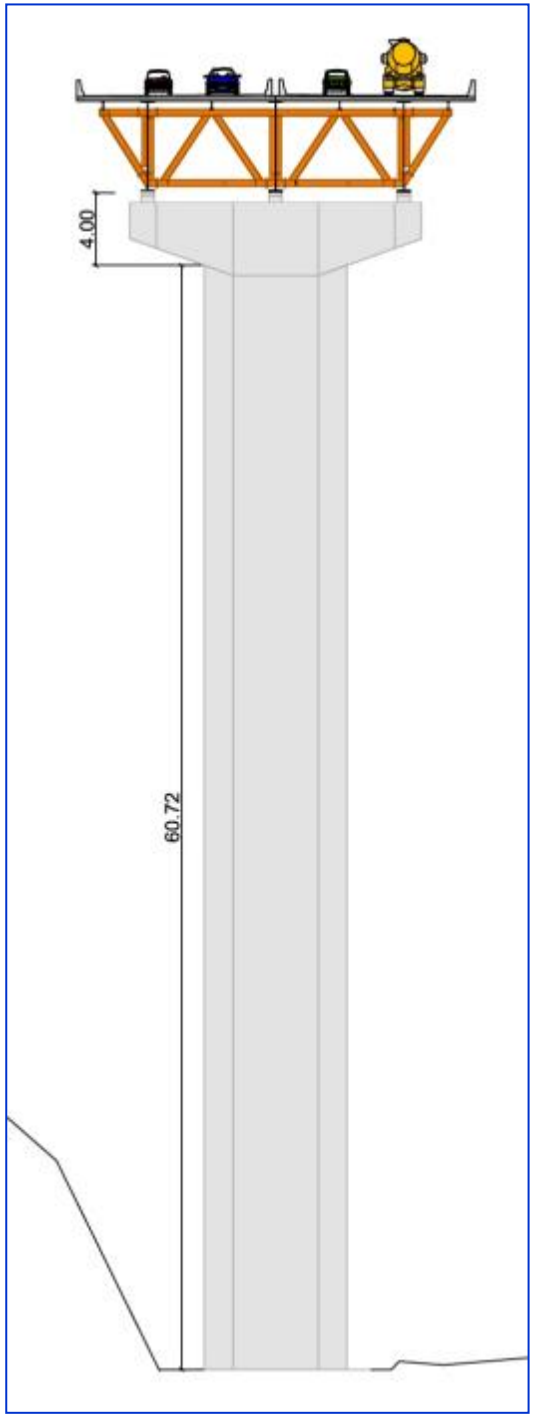
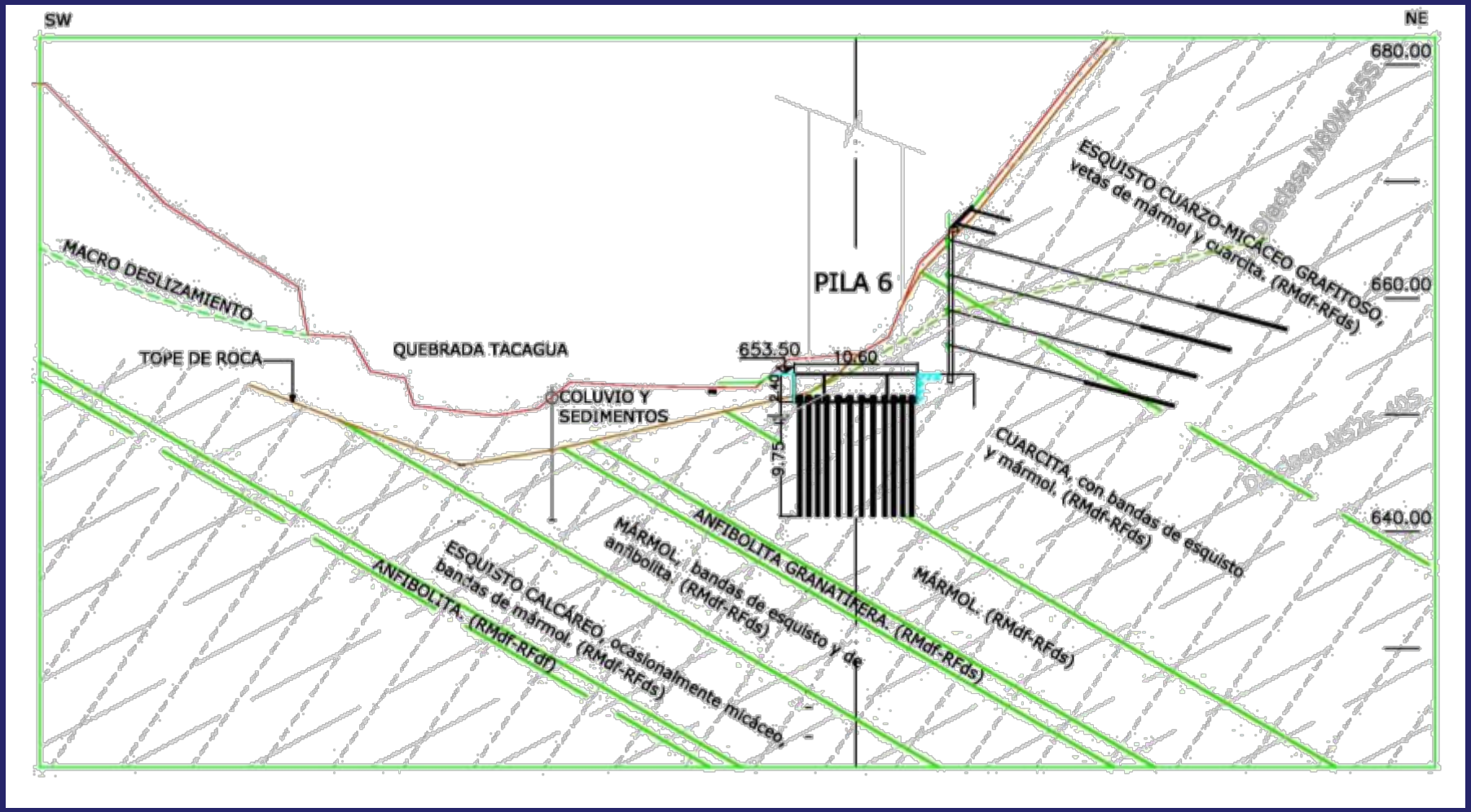



4.00
60.72

New Viaduct



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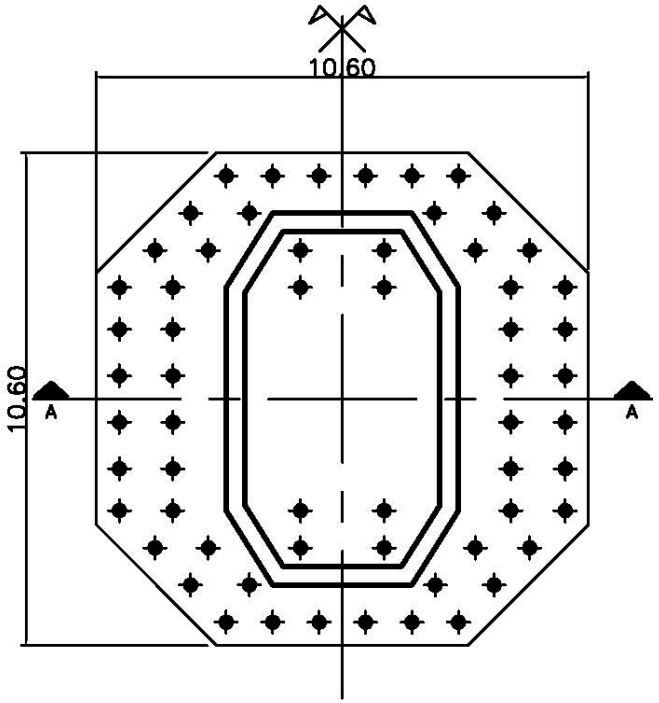
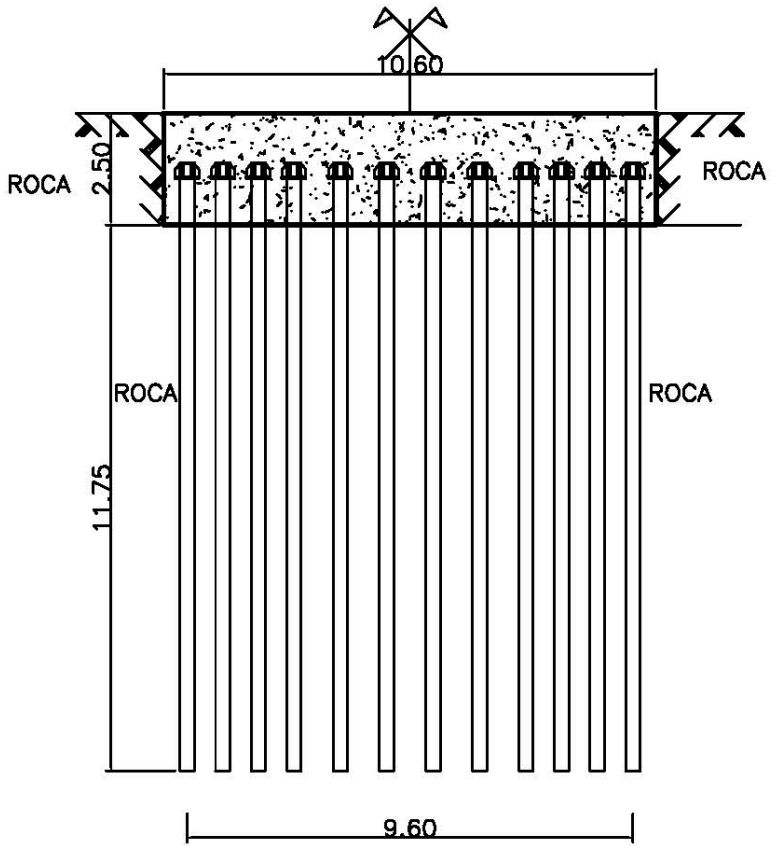
New Viaduct





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Micropile Design

- Performed by micropile installer
- Main considerations:
  - Seismic combinations and significant uplift
  - Corrosion
  - Local practice and materials
  - Need to import casing
  - Site constraints

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Micropile Design

- Site-specific seismic analyses:
  - acceleration coefficient of 0.43
  - site coefficient S=1
  - seismic category D
- Load and Resistance Factor Design (LRFD)
- Extreme Event I was critical combination
- Strength I through V were not critical

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Micropile Design

- Preliminary estimate of minimum casing size
- Closest available casing with suitable pricing procured (Italy)
- Proceeded with final design
  - Calculate factored resistance of pile
  - Determine minimum micropile length

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Micropile Design

- Nominal axial compression resistance 390 metric Tons (859 kip)
- Nominal axial tensile resistance 252 metric Tons (555 kip)
- Resistance Factor of 0.75 and 0.8 in compression and tension, respectively
- Corrosion thickness of 3 mm (0.12 in) around the casing.

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Micropile Design

- Geotechnical resistance selected was 1,200 kPa (25 ksf) from prescriptive values
- For 305 mm (12 in) grout body diameter, minimum bond length 4,900 mm (16 ft)
- Resistance factor of 0.7 as per AASHTO (2007), one load test per site condition
- Final design considered a minimum micropile length of 10 meters (32 ft)

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Micropile Design

- Load testing to be carried to nominal resistance
- Added 10% due to fluidity of design process and local inexperience
- Maximum test load selected at 430 metric tons (947 kip)

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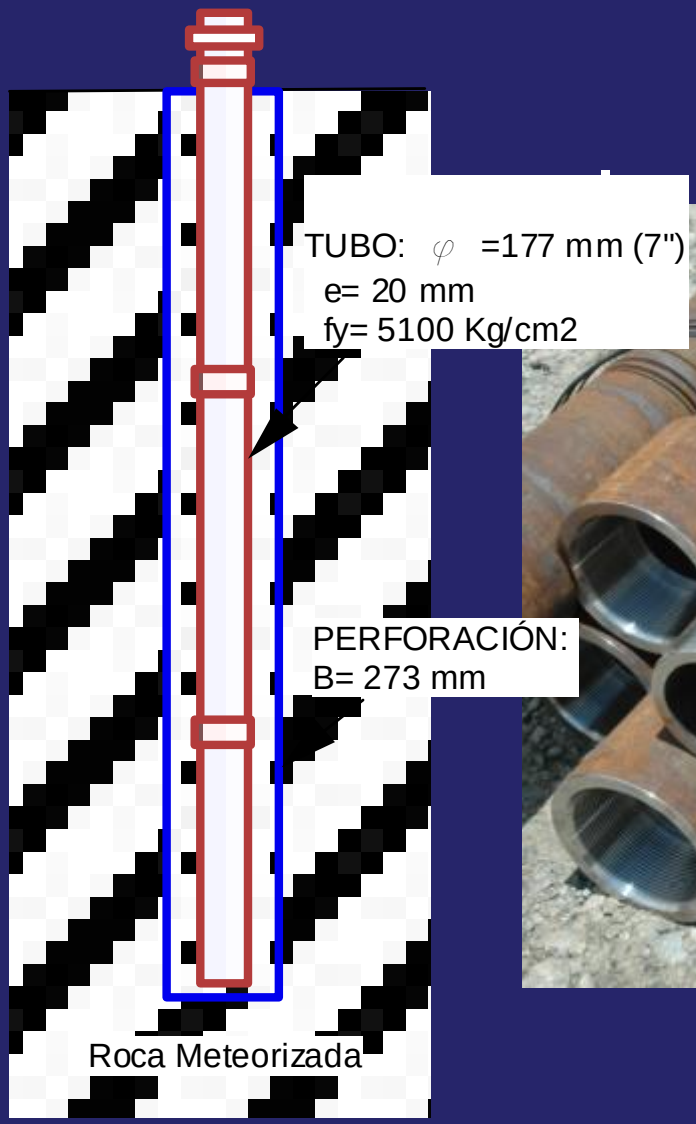
Pilaster No 6



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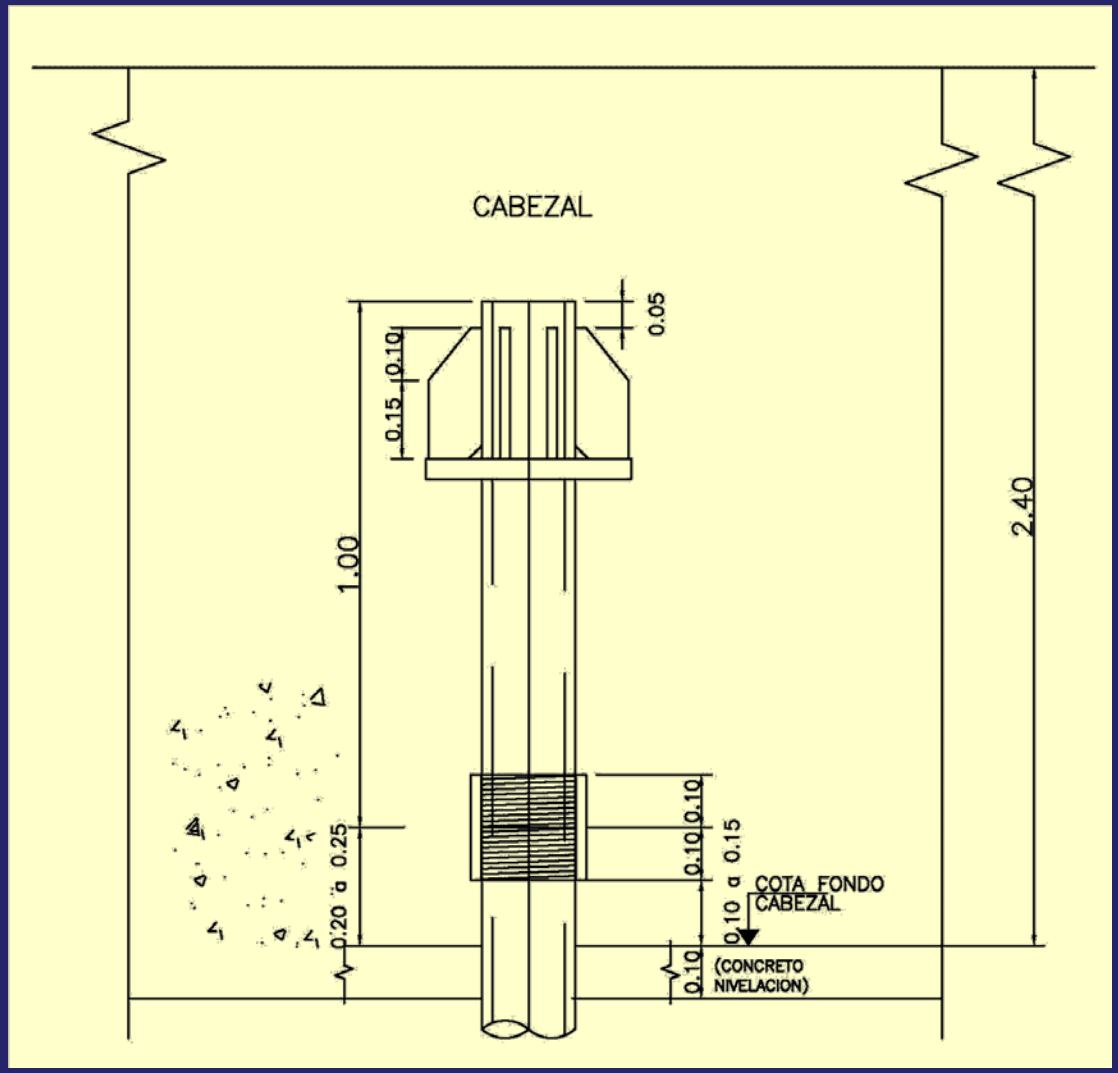
New Viaduct



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Overall View

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New Viaduct

Pilaster No 6

Pilaster No 6

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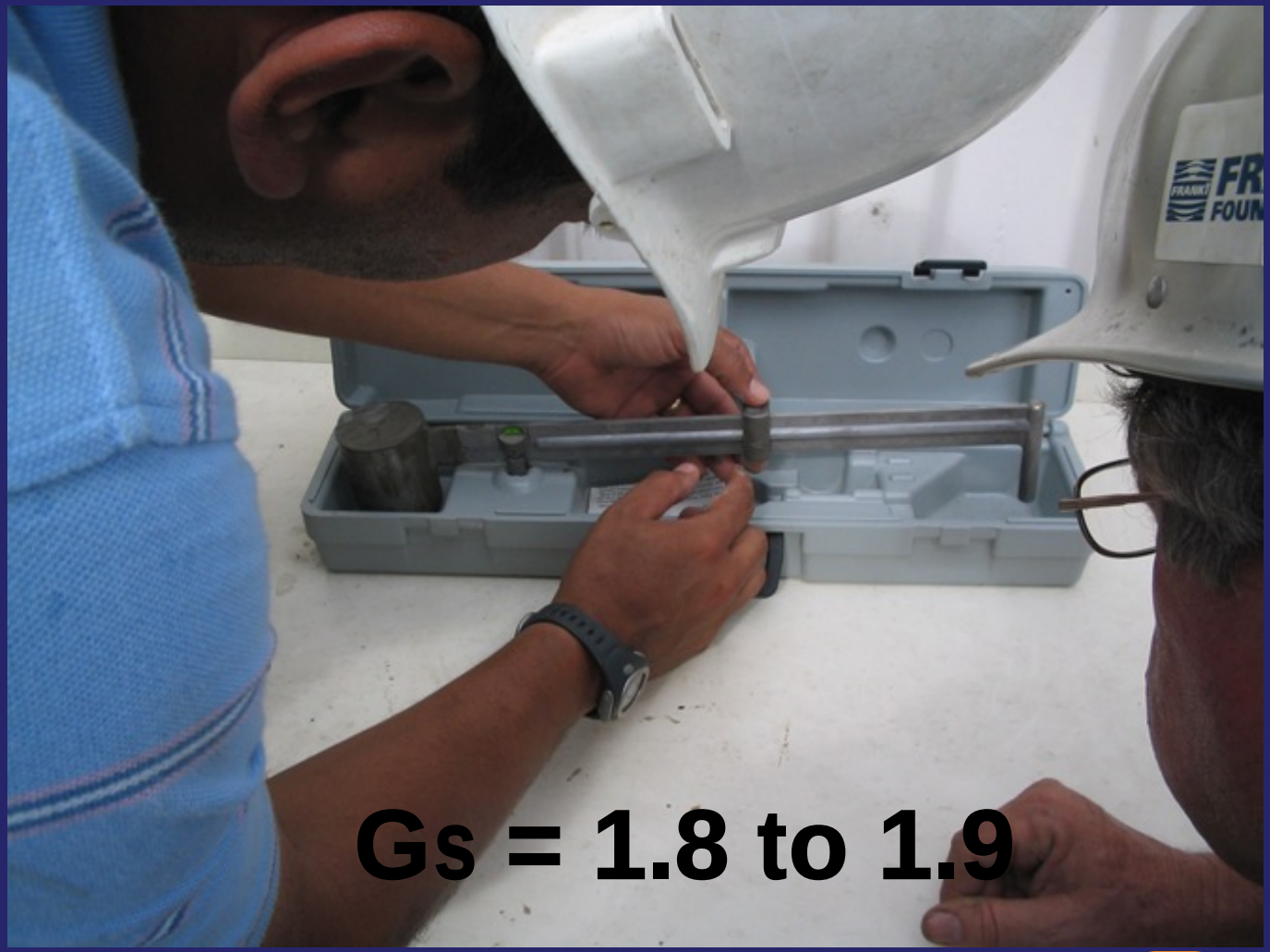
Grout Quality



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Grout Quality

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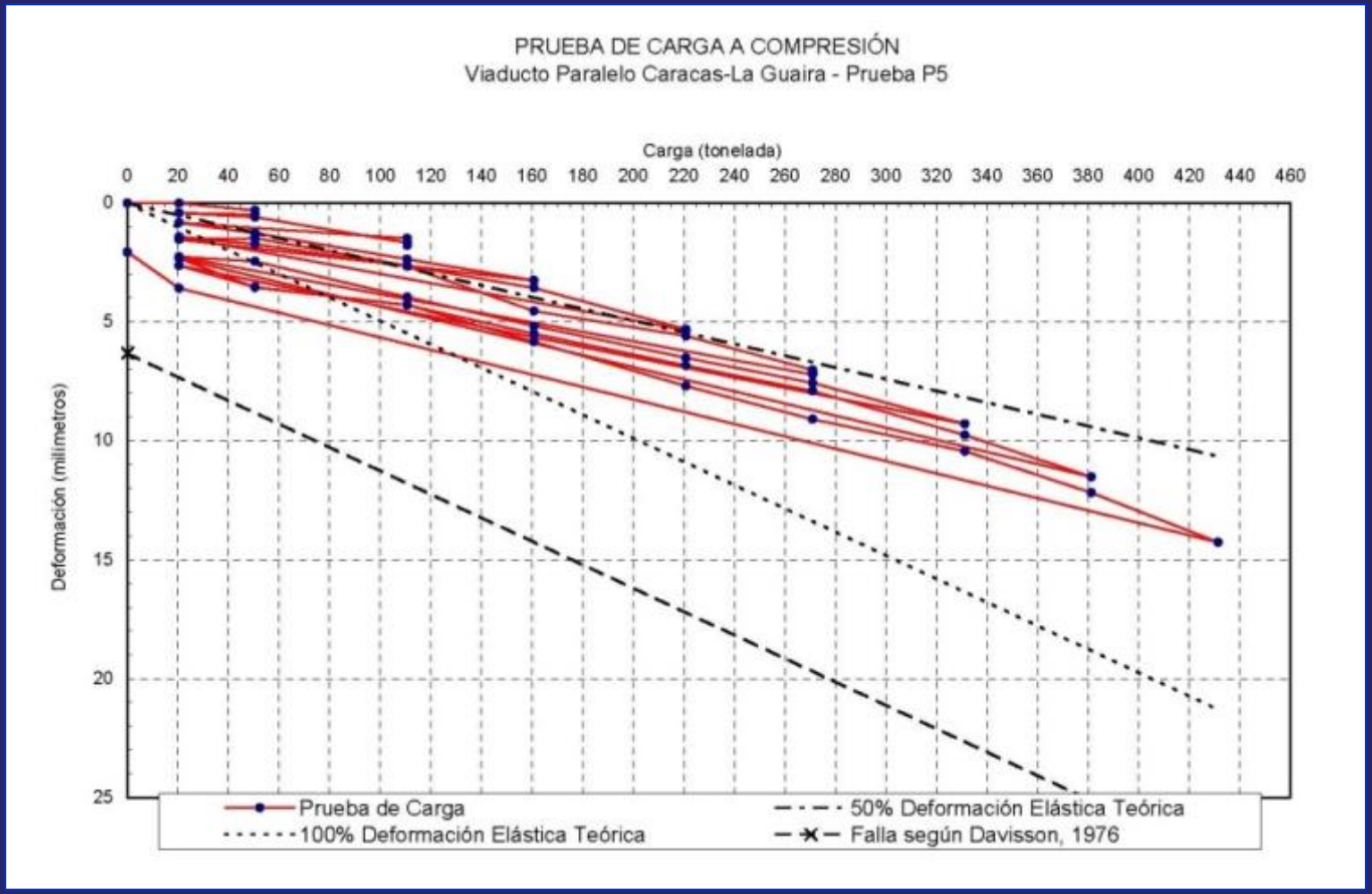
Load Test Pilaster No 5



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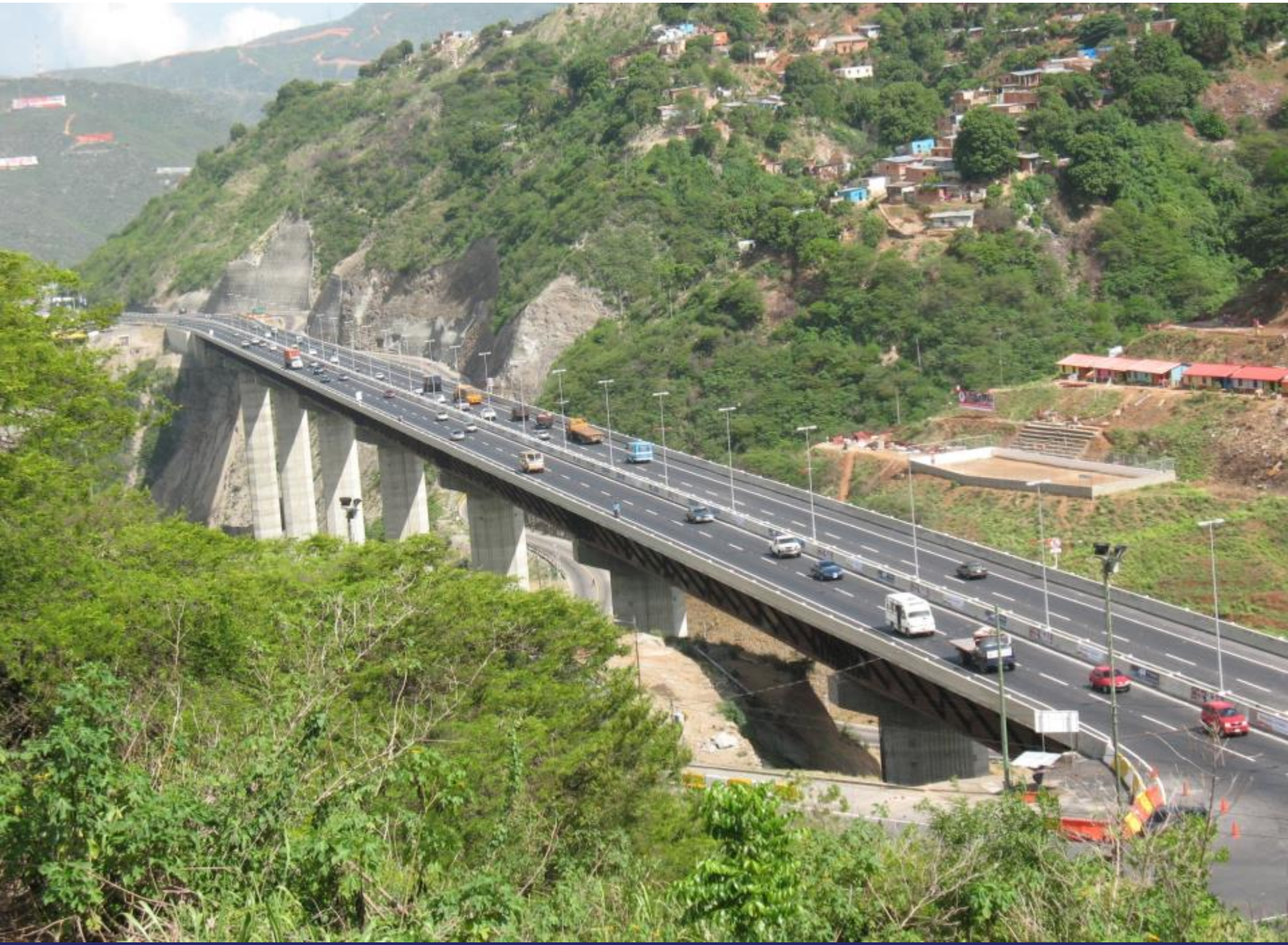

Closure

- Important to test joints, especially if subject to tension
- With coarse threads, tension resistance may be an issue
- Test micropiles to Nominal Resistance
- Simplify top connections and avoid welds, but OK if done in specialized shop

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Closure

- Micropiles provided significant savings
- Viaduct completed ahead of schedule thanks to micropiles
- 21 months total for project completion
- 16 months construction time
- Possibly largest viaduct on micropiles in South America

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Acknowledgements

- Franki Pile Venezuela- Micropile Contractor
- Precomprimidos- General Contractor
- Schnabel Engineering- Micropile Consultant
- Ing. Pedro Carrillo- Geotechnical Consultant

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Thank You

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