30 Years of GEWI-Pile Applications in Canada

International Society of Micropiles

Toronto, Sept 26 - 30, 2007

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GEWI-Piles - Presentation

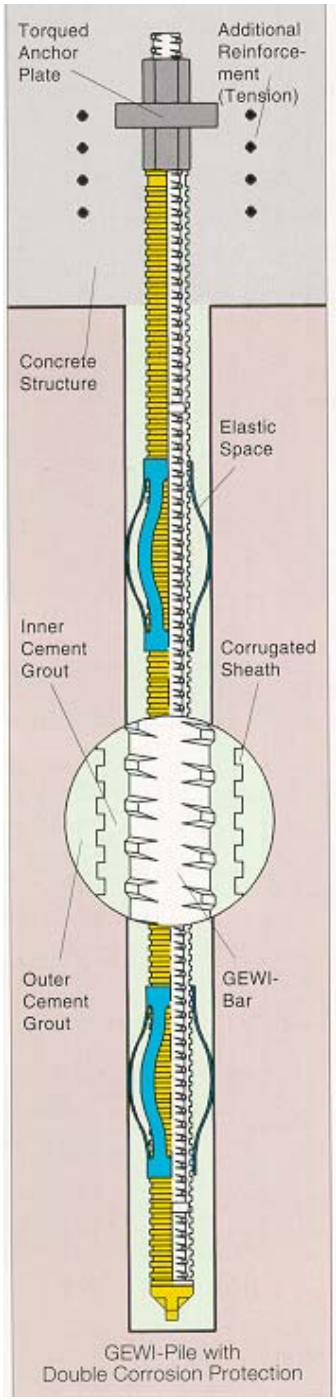
- Introduction
- Definition / System
- Applications
- Summary

Introduction

- Original micropiles or “root piles” by Dr. F. Lizzi - early 50’s
- GEWI-Piles introduced to Western Canada in Mid 1970’s
- The first GEWI-Pile project for an oil storage tank in a refinery, Calgary, 1974
- Winter Olympic Games in Mid 1980’s
- Thousands of GEWI-Piles have been used

Definition

A GEWI-Pile (Threadbar Micropile) is a small diameter, usually less than 300 mm, bored and grouted friction pile with centrically located threadbar(s) as the load carrying element, acting in tension and/or compression.



GEWI-Pile System

- **Grout body encasing Threadbar provides corrosion protection for compression pile.**
- **Double Corrosion Protection (DCP) system used for GEWI-Piles in tension.**
- **Force transfered by friction into rock or soil.**
- **Threadbar provides excellent bond transfer.**
- **Continuous threads provide connection in pile cap.**
- **Add permanent steel casing for additional capacity.**
- **Special grouting techniques improve load carrying capacity.**
- **DCP is an inexpensive corrosion protection system.** (only a fraction of overall installation cost)

GEWI-Pile Grouting Techniques

Type A: Gravity fill techniques.

Type B: Pressure grouting through casing.

Type C: Type A + High-pressure Postgrouting.

GEWI-Pile Applications – logistic advantages

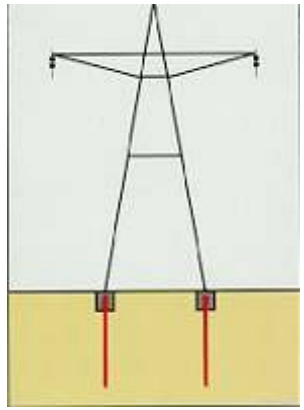
Solving logistic problems such as:

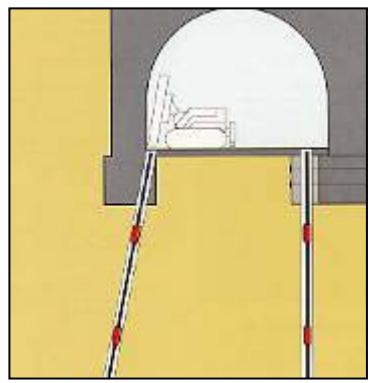
1) Difficult access to sites

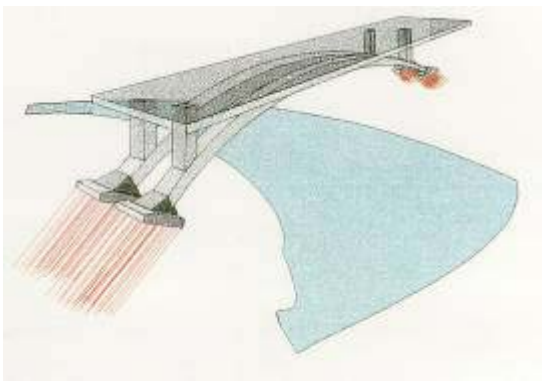
2) Low headroom

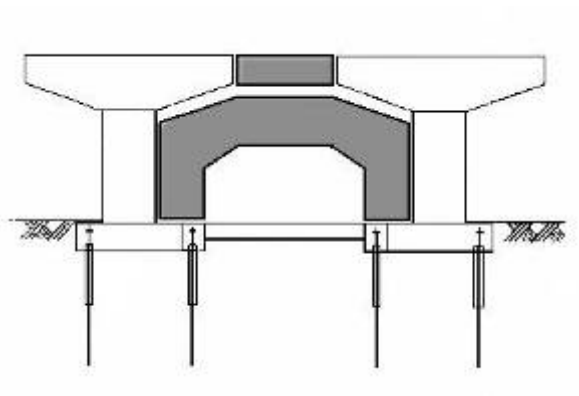
3) Tight and congested work areas

4) Difficult soil conditions









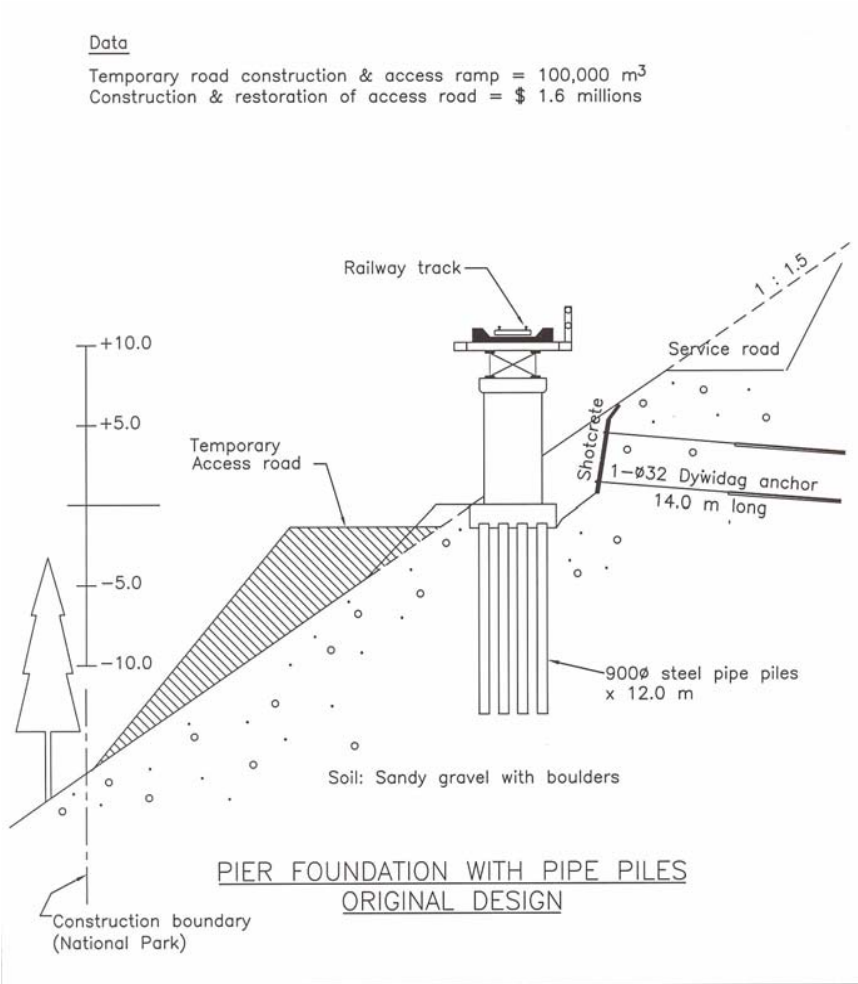
GEWI-Pile Applications – logistic advantages, continued..

1) Access to sites

- Along steep slopes (Rogers pass, BC, 1985)
- Foundation in remote sites (Dew Lines, 1990)

CP Rail Viaduct at Roger's Pass, BC – 1985

CP Rail Viaduct at Roger's Pass, BC – 1985



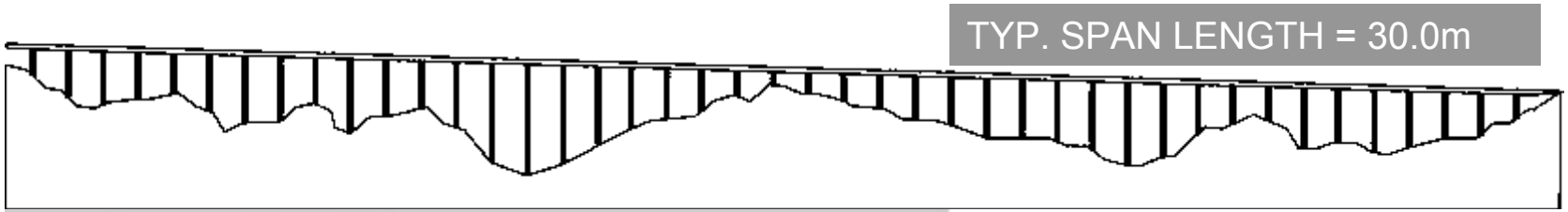
Original Design

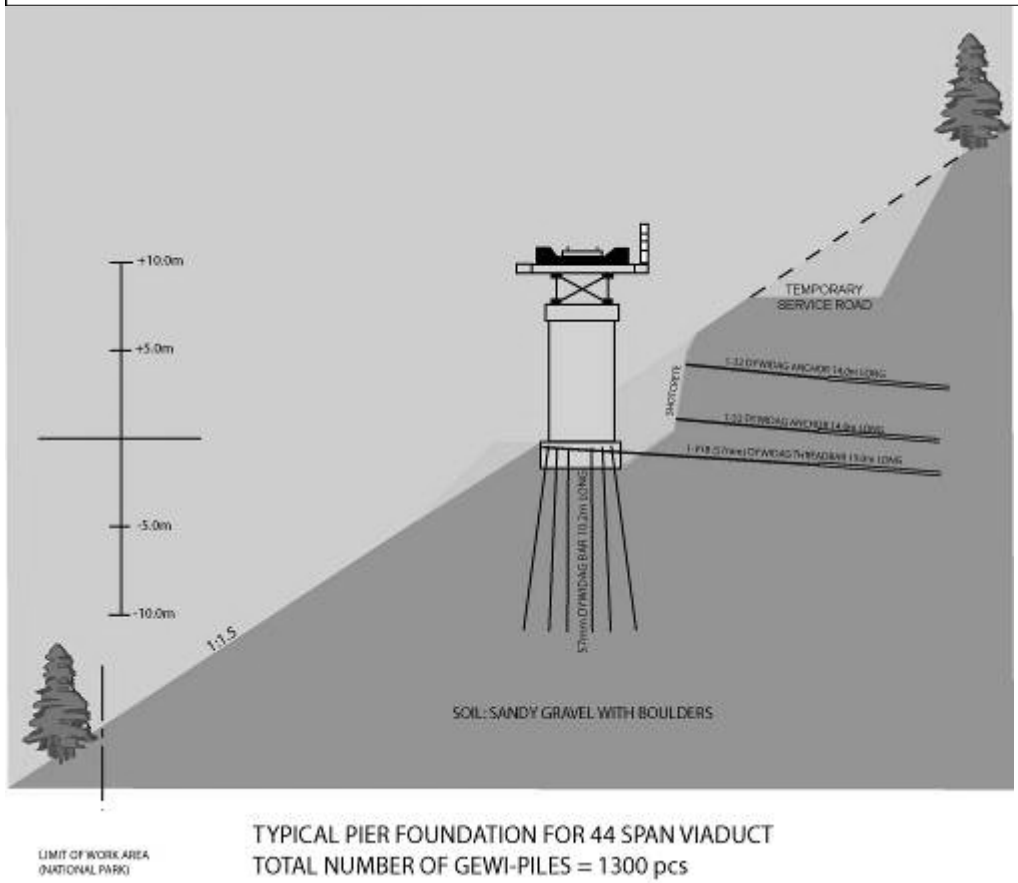
900ø steel pipe-piles

12 m deep, vertical

Note the embankment required to support the temporary access road for heavy piling equipment

CP Rail Viaduct at Roger's Pass, BC – 1985





TYPICAL PIER FOUNDATION FOR 44 SPAN VIADUCT
TOTAL NUMBER OF GEWI-PILES = 1300 pcs

Alternative Design (As-built)
DYWIDAG GEWI-Piles

57ø gr. 517MPa tested to 1,020kN
140ø borehole
1,300 x 9 m deep at 20º
Single Corrosion Protection
Pressure grouted through casing

GEWI-Pile pier foundations for Elevated Buildings, Dew Line, 1990

#14 Grade 413MPa Bar

Working load 165kN

Test load in tension 330kN

GEWI-Pile for vertical piers

Borehole 127mm

Embedment length in rock 4 - 10m

Cement Fondue grout

Easy transport of materials & equipment

GEWI-Piles Applications – logistic advantages, continued..

2) Low headroom

- **Seismic Upgrading of existing Schools (Britannia School in Vancouver, 1993)**

- **Underpinning for additons (Tiptop Tailors Building, Toronto, 2003)**

Seismic Upgrade of Britannia School in Vancouver, 1993

57Ø DYWIDAG GEWI-piles with Double Corrosion Protection (DCP) in aggressive soils.

Pre-production Compression and Tension cyclic testing

Seismic Upgrade of Britannia School in Vancouver, 1993

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Seismic Upgrade of Britannia School in Vancouver, 1993

Tested GEWI-Piles ready to receive reinforcing steel and concrete

Seismic Upgrade of Britannia School in Vancouver, 1993

Inclined Compression load testing of production GEWI-Piles

Underpinning of Tiptop Tailors Building, Toronto, 2003

Drilling of GEWI-Piles at Tiptop Tailors Building, Toronto, 2003

Installation of GEWI-Pile at Tiptop Tailors Building, Toronto, 2003

Testing of GEWI-Pile at Tiptop Tailors Building, Toronto, 2003

GEWI-Piles Applications – logistic advantages, continued..

3) Tight and congested work areas

- Irving Tissue Plant, Toronto, 2003
- University of Toronto CBTC, 2006

GEWI-Pile Foundation for Irving Tissue Plant, Toronto, 2003

GEWI-Pile Foundation for Irving Tissue Plant, Toronto, 2003

University of Toronto CBTC, 2006
GEWI-Pile (2 x 63mm DCP), Compression tested to 325 Tons

University of Toronto CBTC, 2006

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University of Toronto CBTC, 2006

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GEWI-Piles Applications – logistic advantages, continued

4) Piles in difficult soil conditions:

- Big Qualicum Bridge, BC, 1996

- Vancouver International Airport, BC, 1994 - 2006

Big Qualicum Bridge, Vancouver Island, BC, 1996

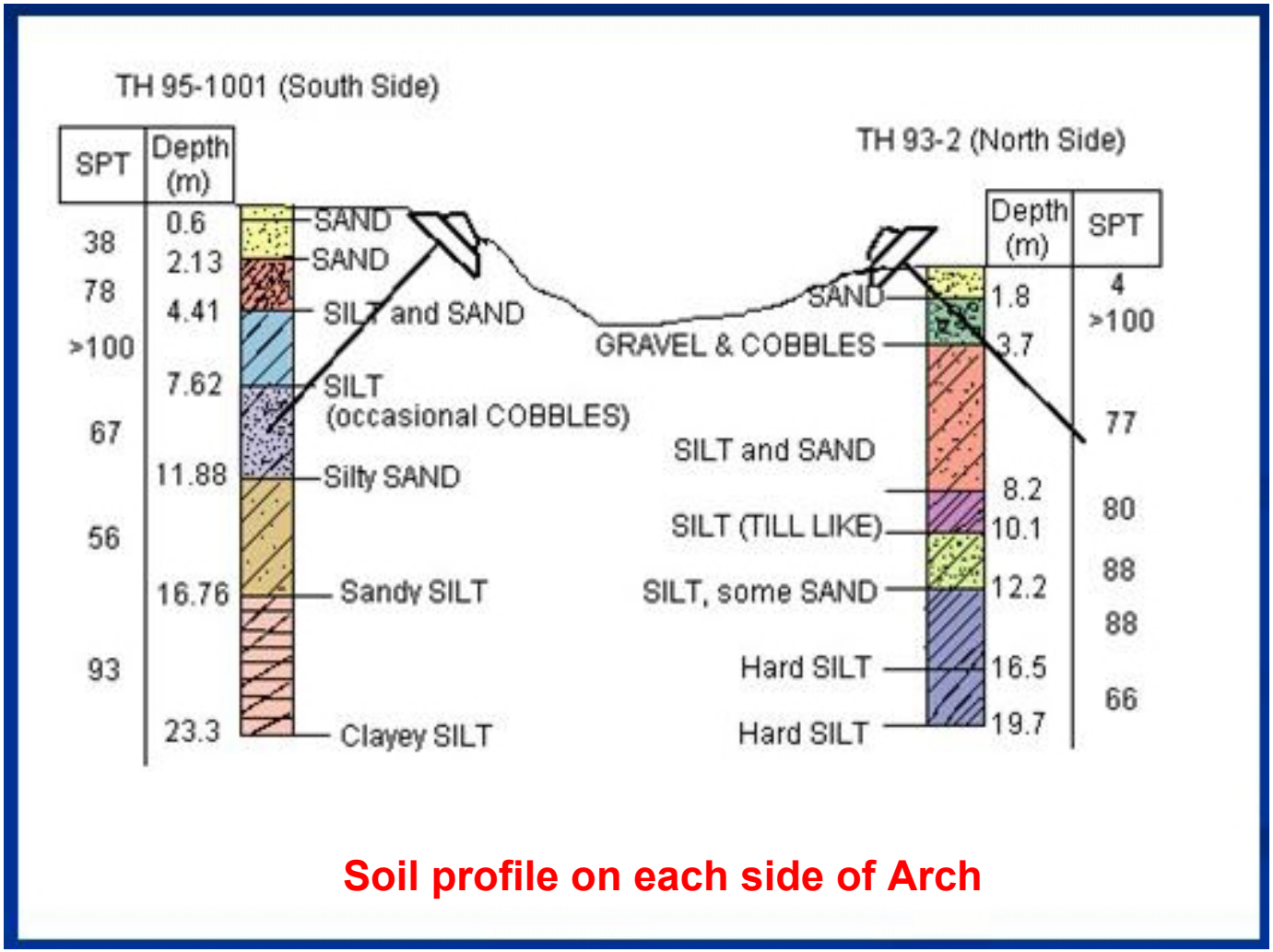
57Ø DYWIDAG GEWI-piles with Double Corrosion Protection (DCP) in aggressive soils.

Length 13.0m

Big Qualicum Bridge, Vancouver Island, BC, 1996

Sand, silts, gravel mixture with cobbles & boulders
Pw = 1,200 KN
Tested to 2,200 KN
57Ø DYWIDAG DCP bar
230Ø x 13 m in compression

Big Qualicum Bridge, Vancouver Island, BC, 1996



Soil profile on each side of Arch

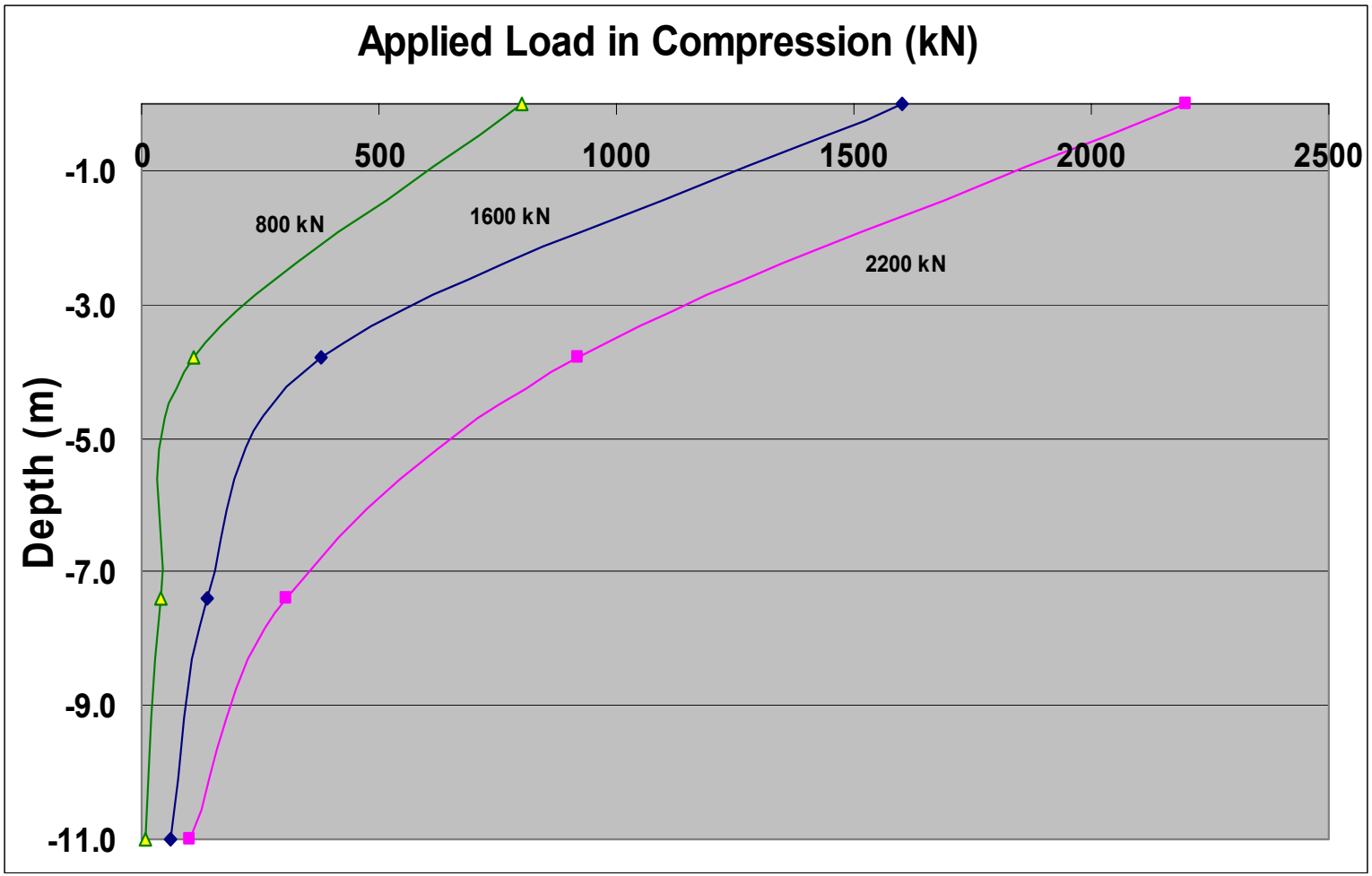
Big Qualicum Bridge, Vancouver Island, BC, 1996

Pre-production load test of 57Ø GEWI-Piles in compression

Theoretical ultimate capacity of 57Ø Threadbar 1780 kN

Failure occurred in compression, above ground, at 2200 kN

Big Qualicum Bridge, Vancouver Island, BC, 1996



Vancouver International Airport

Compression Testing of Post-grouted GEWI-Piles using adjacent piles as reaction.

Vancouver International Airport

Summary

- 30 years of proven performance.
- Bar size: 50Ø -> 75Ø, yeild load: 1,000kN -> 3,000kN
- GEWI-Piles (Micropiles) provide cost-effective solution under difficult logistical conditions.
- Multiple bars & steel pipe combination provide high capacity micropiles (up to 500 tons).
- High-pressure postgrouting increases soil/grout bond by up to 3 times versus gravity grouting.
- Double corrosion protection provides a reliable corrosion protection for GEWI-piles to assure long service life.

Thank-you!