

# Post-Grouting Systems for Micropiles

DYWIDAG-SYSTEMS  
INTERNATIONAL



*Chris Irvin*



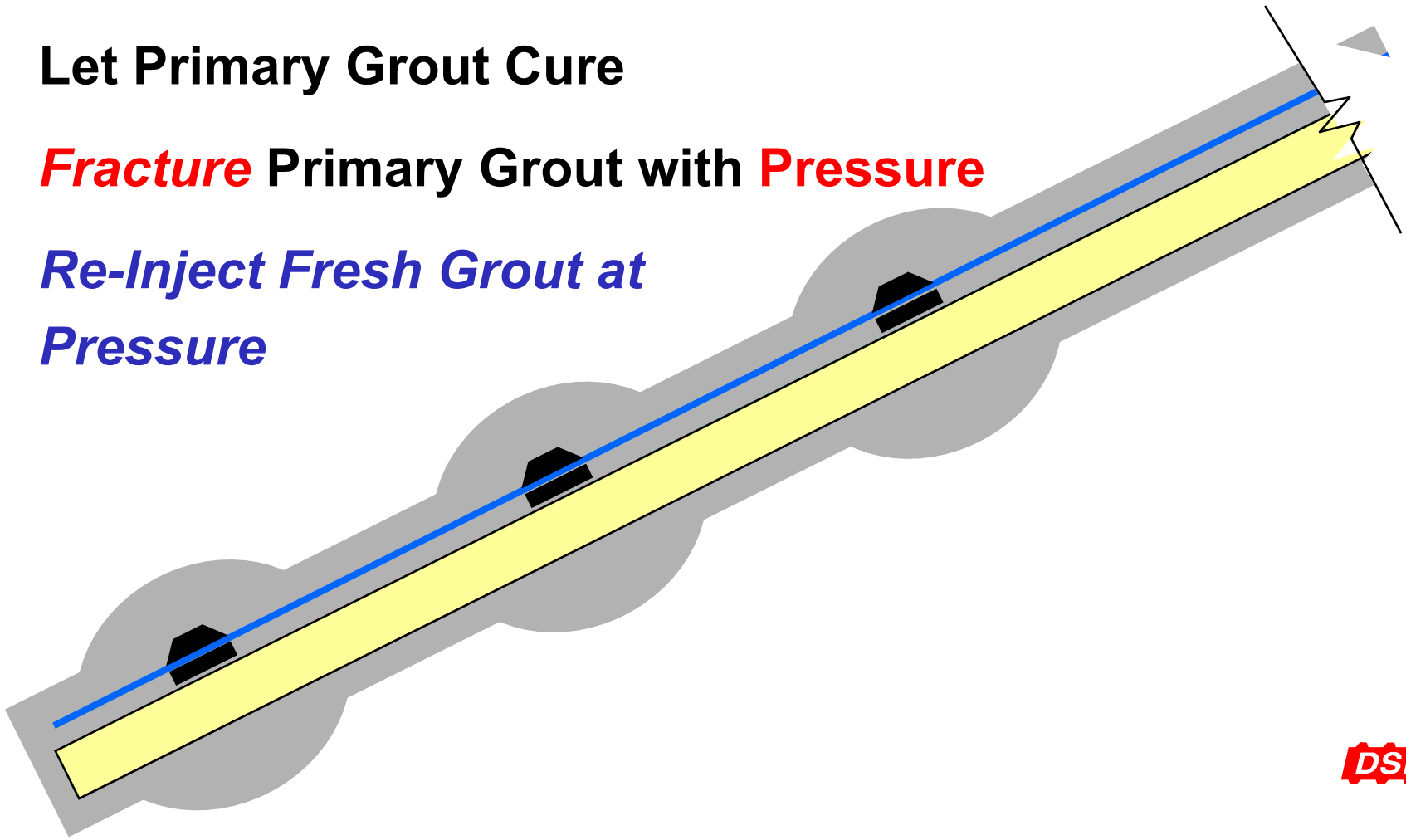
*Clif Kettle*

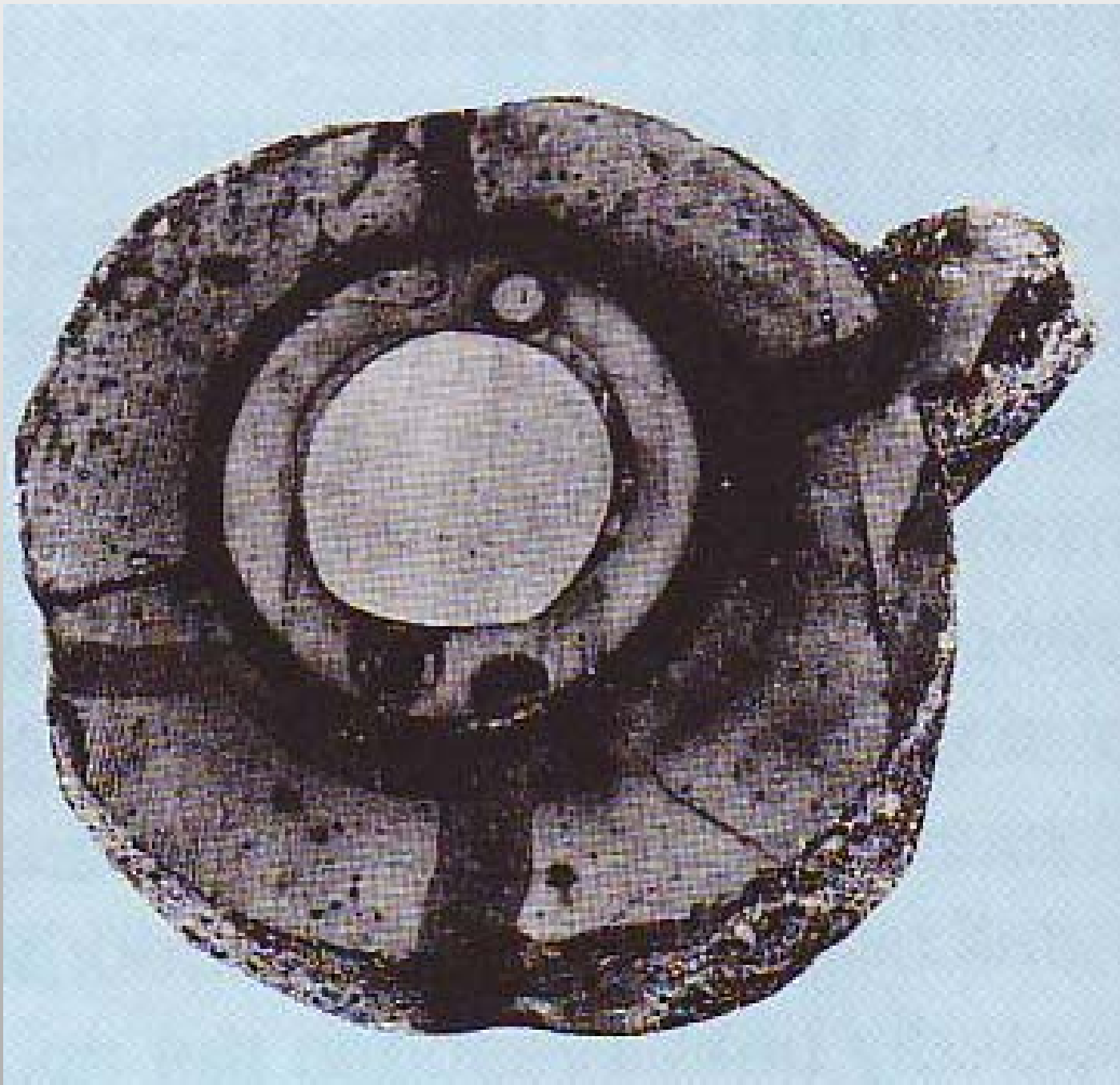


*Mike Turner*

# Post-Grouting Procedure

1. Install Micropile or Anchor with *Post Grouting Tubes and Valves*
2. Fill Borehole with Primary Grout
3. Let Primary Grout Cure
4. *Fracture* Primary Grout with **Pressure**
5. *Re-Inject Fresh Grout at Pressure*

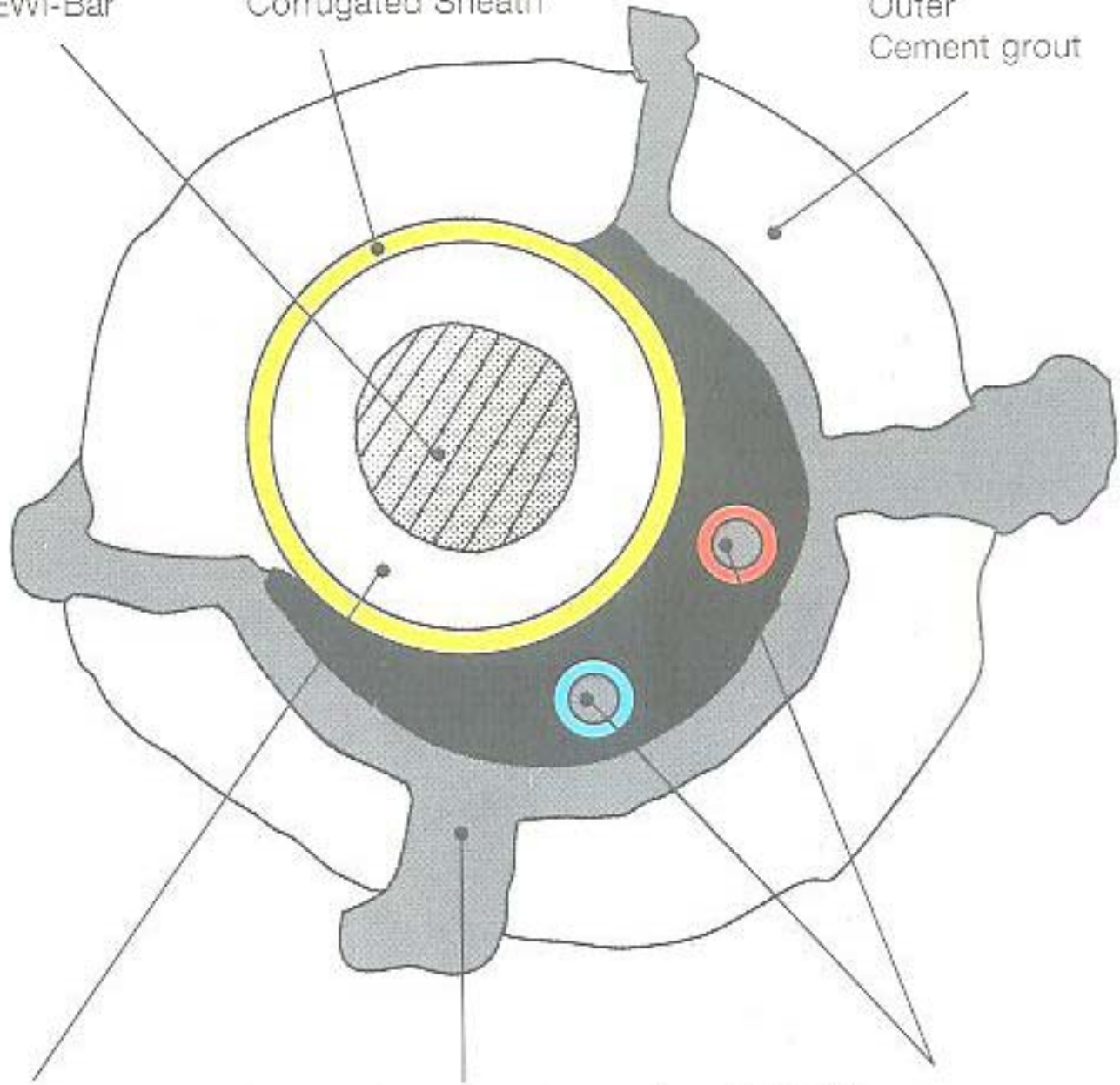




GEWI-Bar

Corrugated Sheath

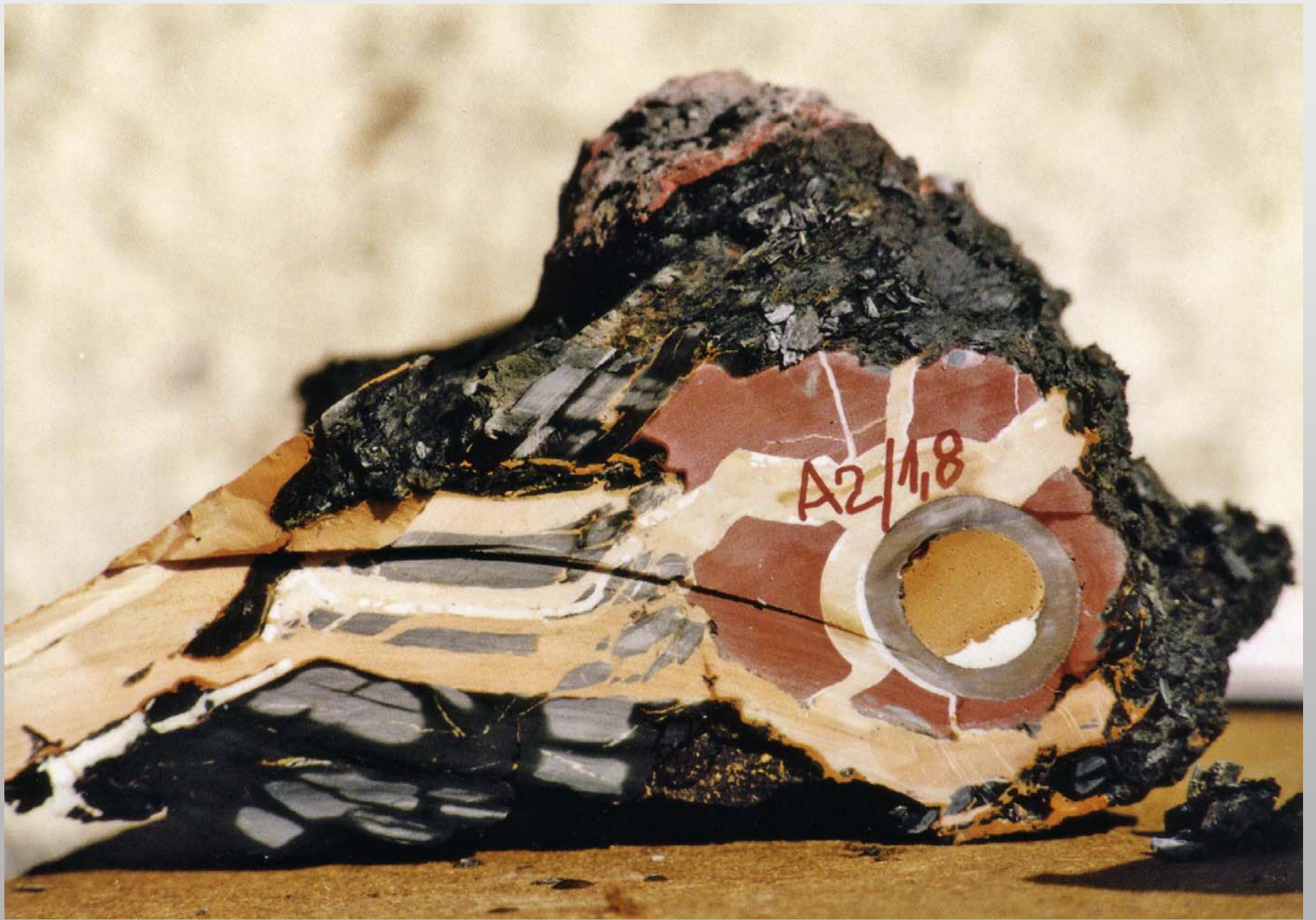
Outer  
Cement grout



Inner  
Cement Grout

Cement Grout, postgrouted

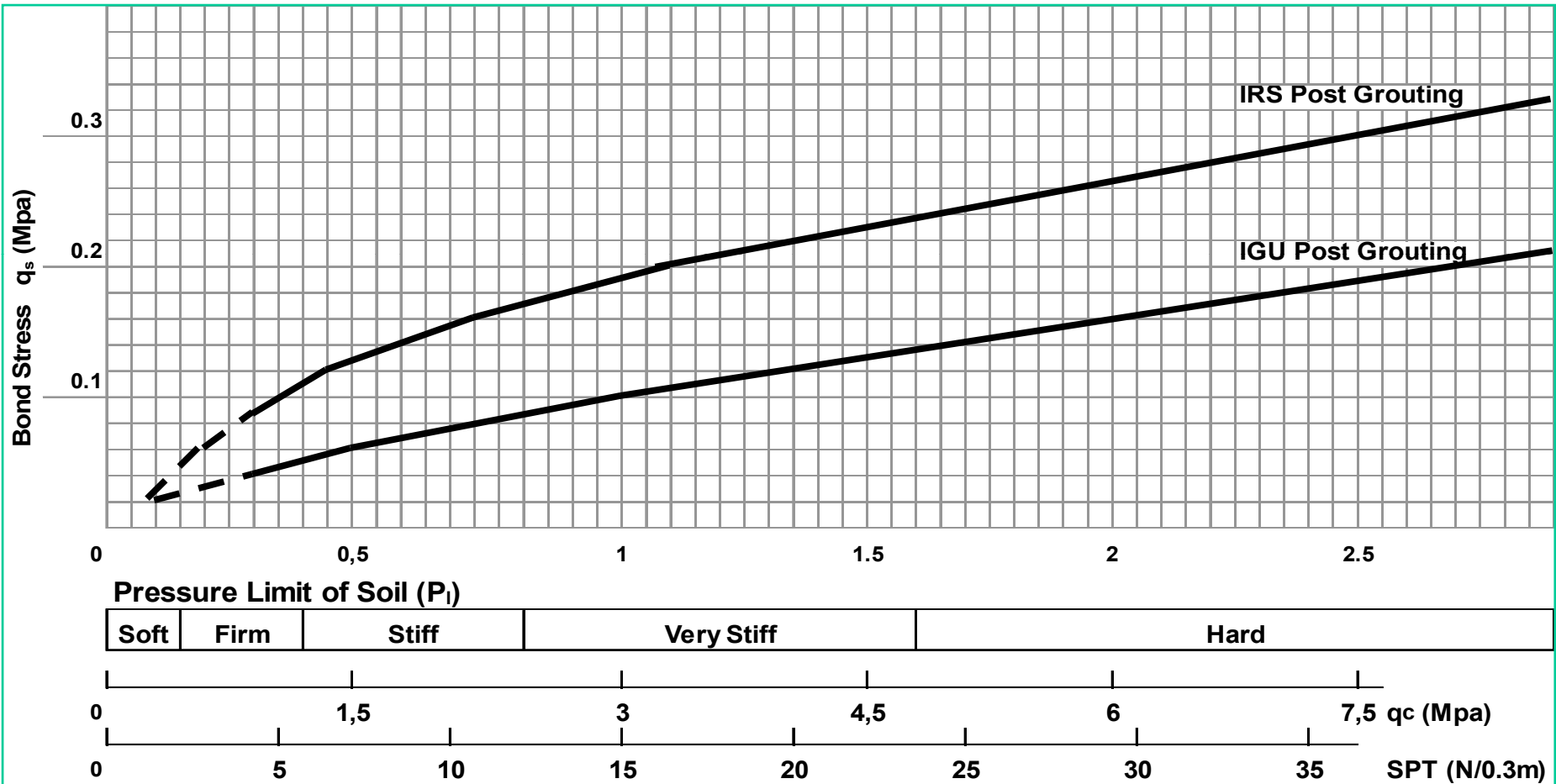
High Pressure  
Grout Tubes



# **Increased Load Performance with *POST-GROUTING*:**

- Subjects Surrounding Ground to Radial Stresses**
- Stiffens / Consolidates the Soil In-Situ**
- Increases Effective Borehole Diameter**

# Empirical Relationship between *Ultimate Bond Stress* and Limit Pressure from Pressuremeter or SPT (N Value) for Silty Clay



after Bustamante et al

# Post Grouting Systems:

- **Looped Tube Systems** (*IGU*)
- **Staggered Multiple Tubes**
- **Tube-à-Manchette, TAM or TMD, (*IRS*)**



# Looped Tube System *(IGU)*







## **Permanent GEWI Micropiles (with Double Corrosion Protection)**

***Post-Grouted  
(Looped Tube  
System)***



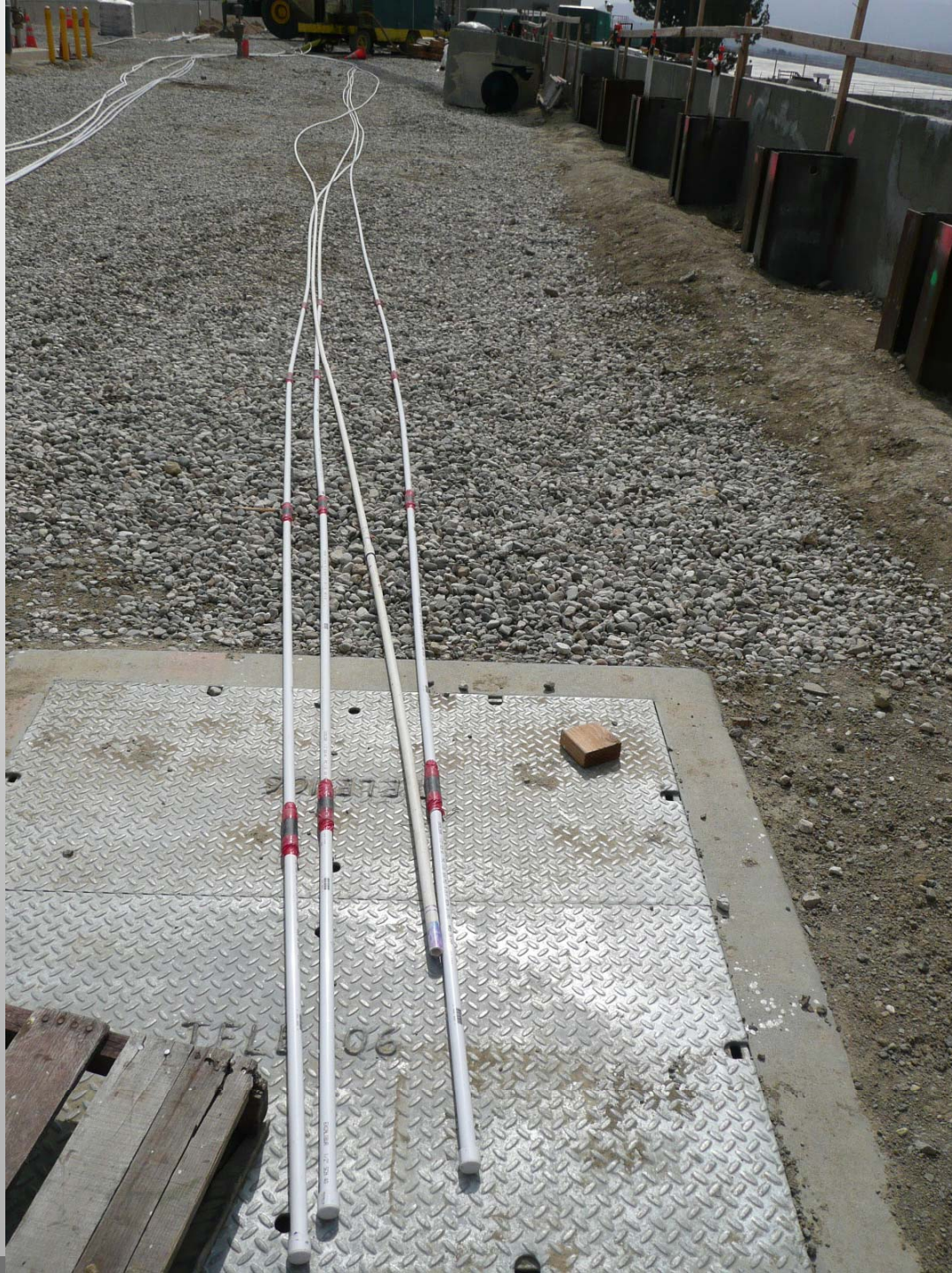
# Basement Slab Uplift Resistance

**Permanent GEWI  
63.5mm Micropiles**  
(with Double Corrosion  
Protection)

***Post-Grouted  
(Looped Tube  
System)***







# ***Staggered Tube System***

- **2 or 3 Tubes per Borehole**
- **2-4 Valves per Tube**
- **Valves placed at differing depths (*stages*)**



# Close Up of Valve

*(Staggered Tube System)*

Laid alongside  
Micropile

(Micropile shown with  
Double Corrosion  
Protection, DCP)







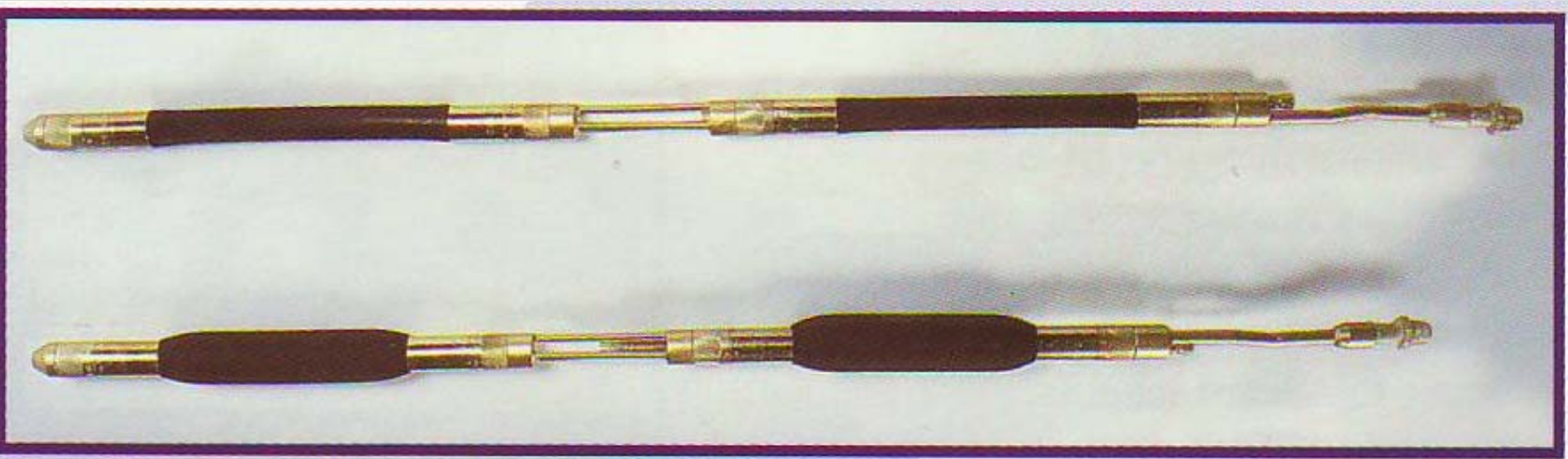
# Tube-à-Manchette System (TAM) *IRS*

*(shown installed between strands: temporary strand anchor)*



# Double Packer Injection Tool

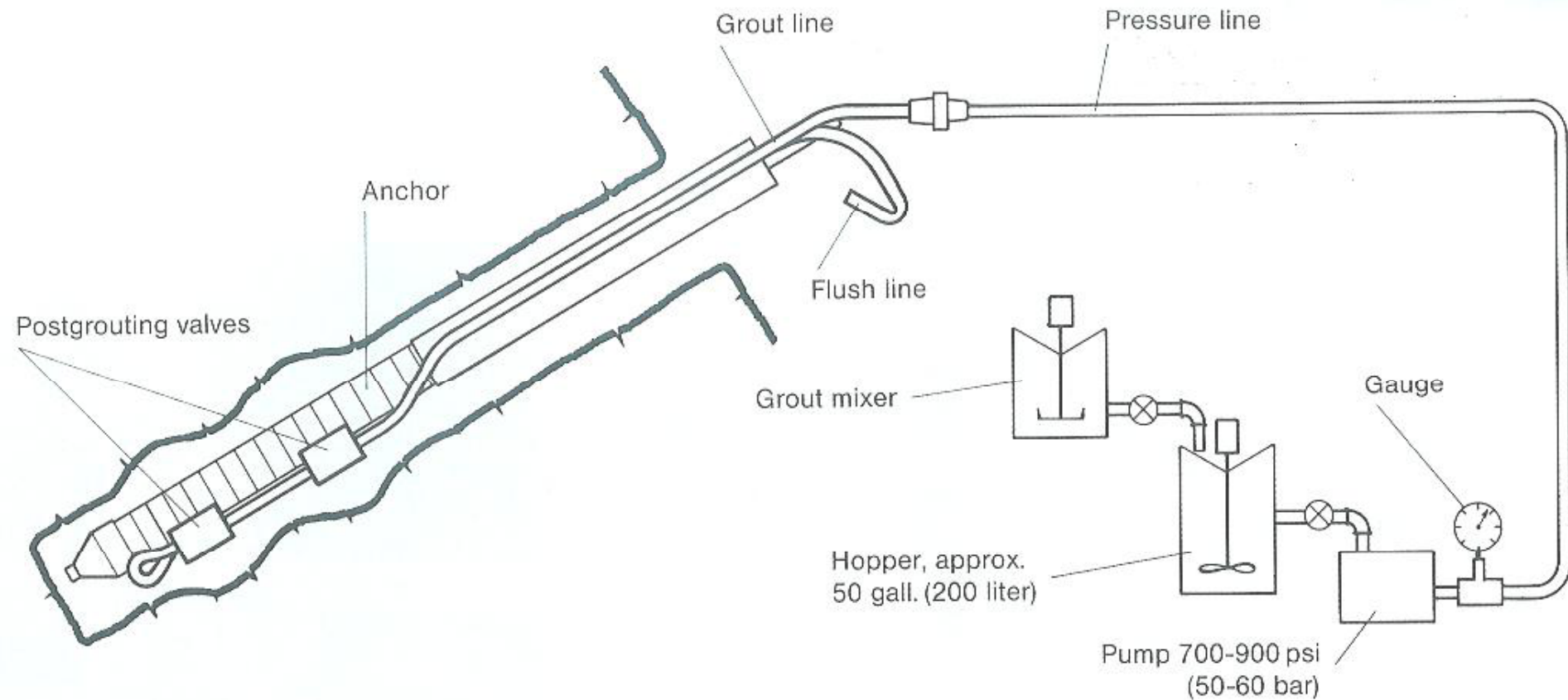
Un-Inflated



*Inflated*



## Post Grouting Equipment – (IGU System shown)



**Grout Mixing Unit**  
**High Pressure Grout Pump**  
**Pressure Line**  
**Post Grouting Pipework / System (IGU)**







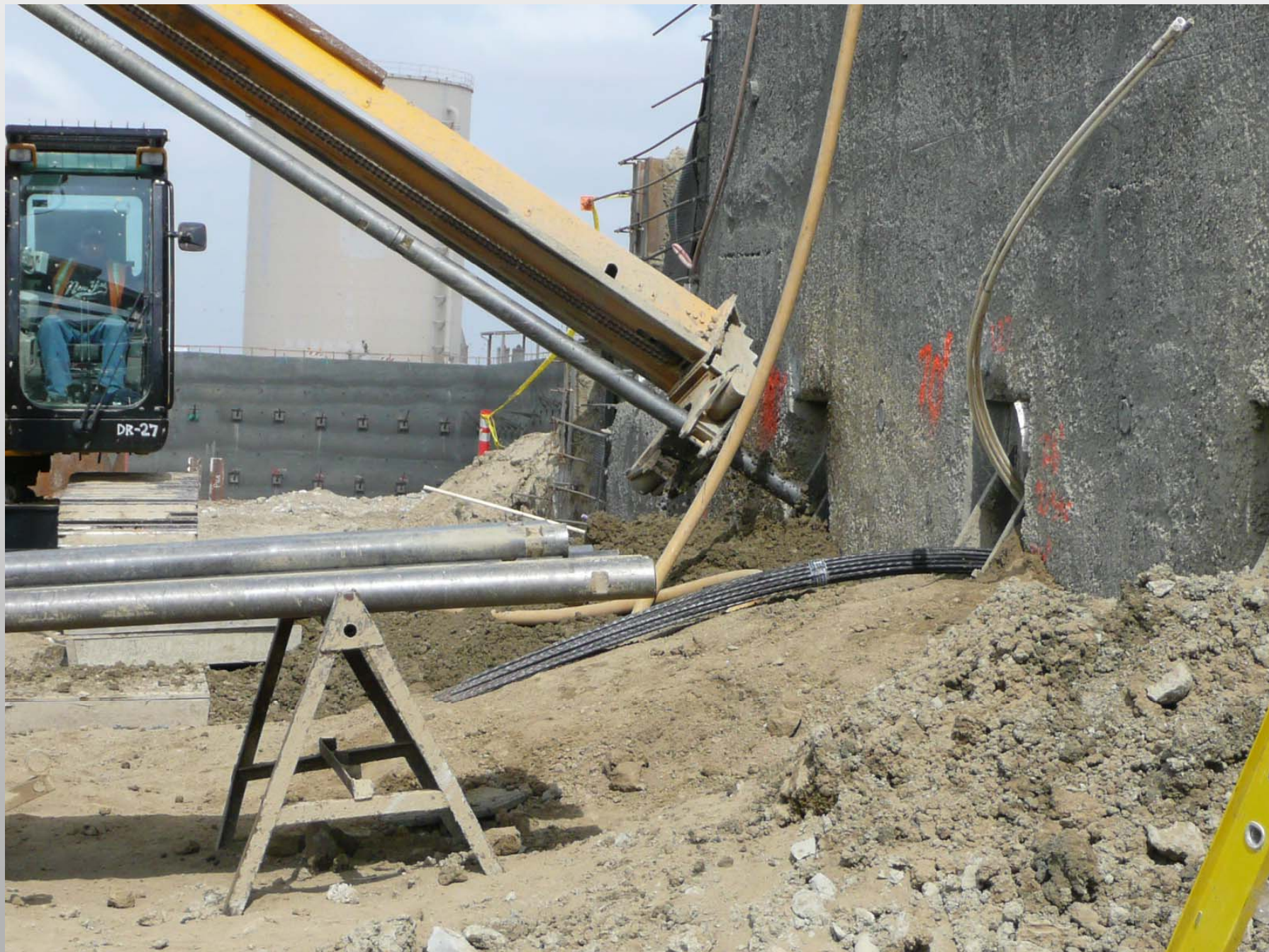


## **Staggered Tube System**

***(Staged Tubes with twin valves)***

















# Tube-à-Manchette System (TAM)

















**Double Packer Inflation Pressure (40 Bar)**







**Fracture Pressure (up to 70 Bar)**





***Injection Pressure 5-10 Bar***



# Micropiles in Restricted Access Locations

***Post-Grouting*** is the ideal technique for increasing load capacity in difficult ground

# Projects Using Post-Grouted Micropiles

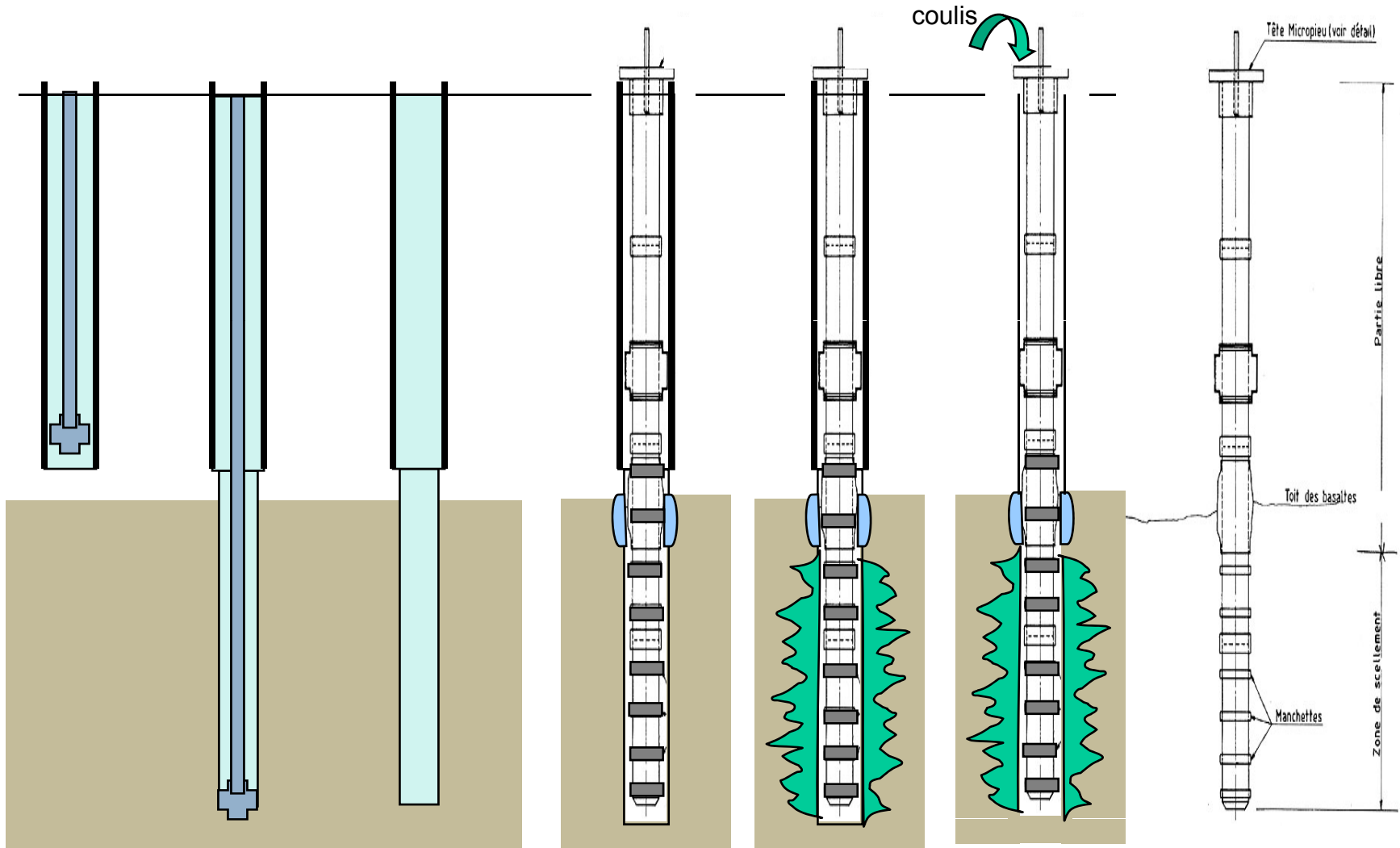


*Clif Kettle*

# Typical TMD Installation Sequence

DISPOSITIF GENERAL MICROPIEU  
TYPE 650 KN

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PHASAGE D'EXECUTION DES MICROPIEUX

## TMD System – Micropiles



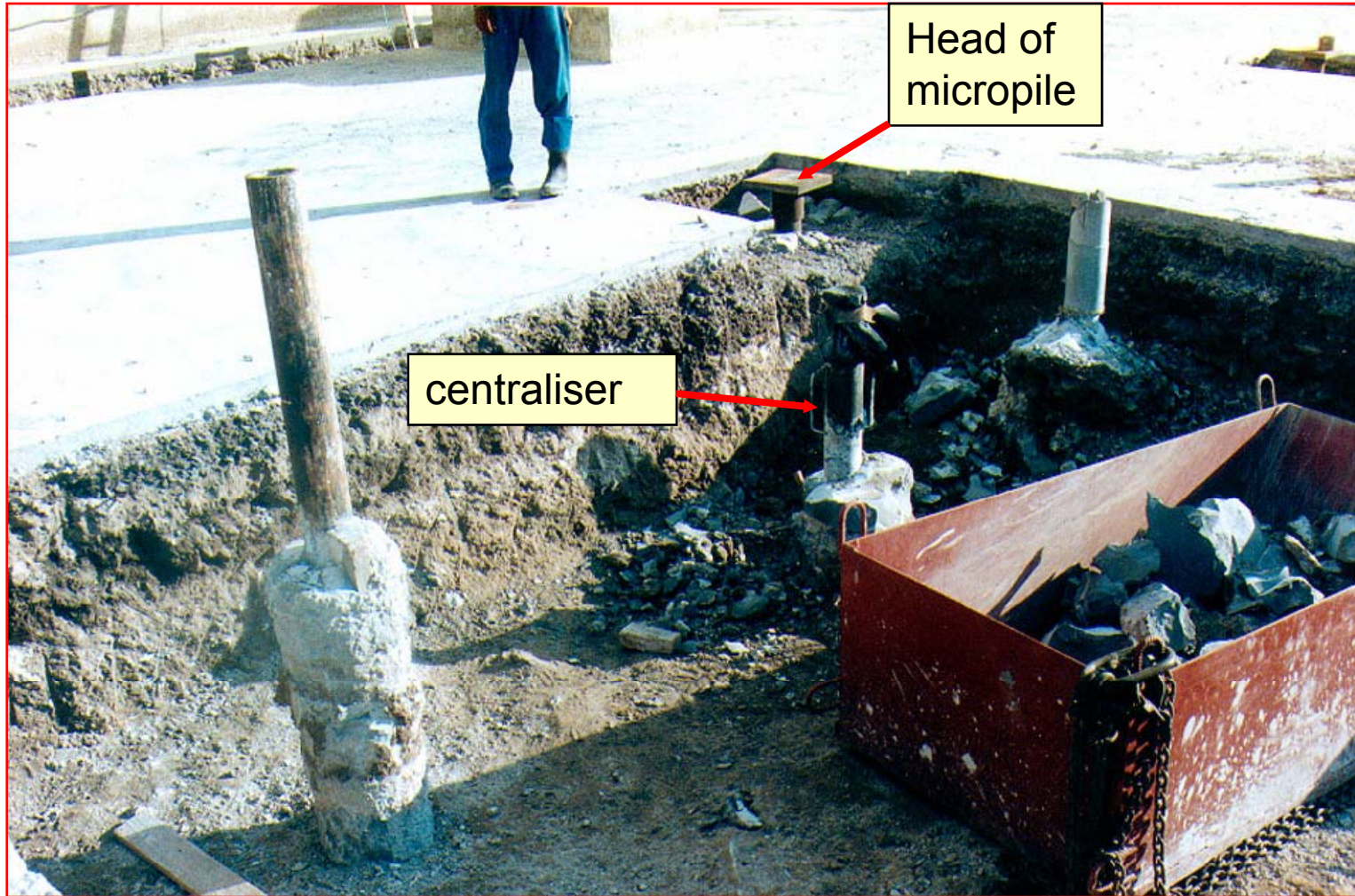


# Fort George Power Station

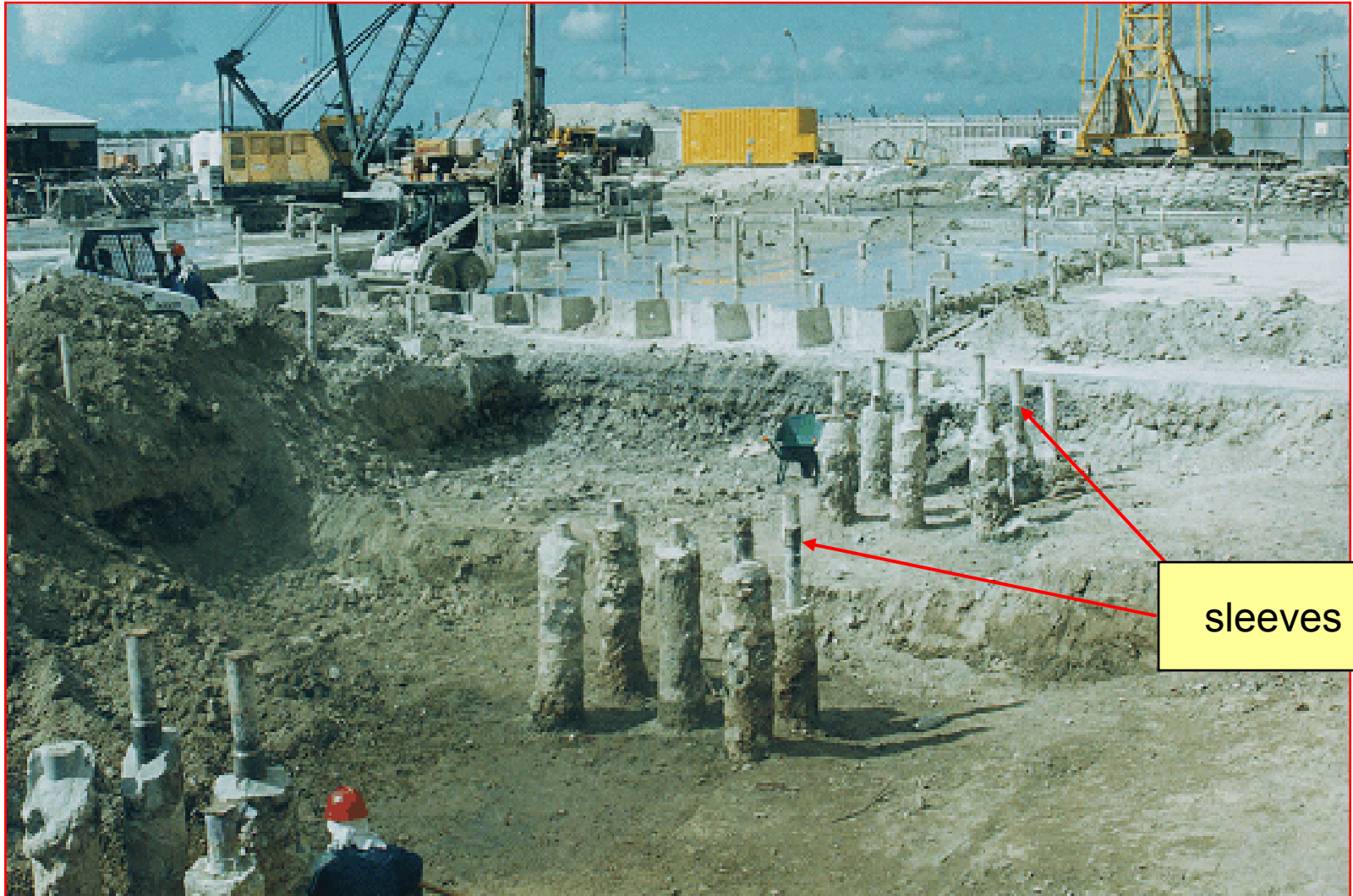
Drilling by DTH Hammer



# Fort George Power Station



# Maurice Power Station



sleeves



# Fort George Power Station



Détail des systèmes de reprise d'effort en attente avant exécution du radier

# Rue Raynouard - Paris 16ème - Foundation Remediation with Micropiles

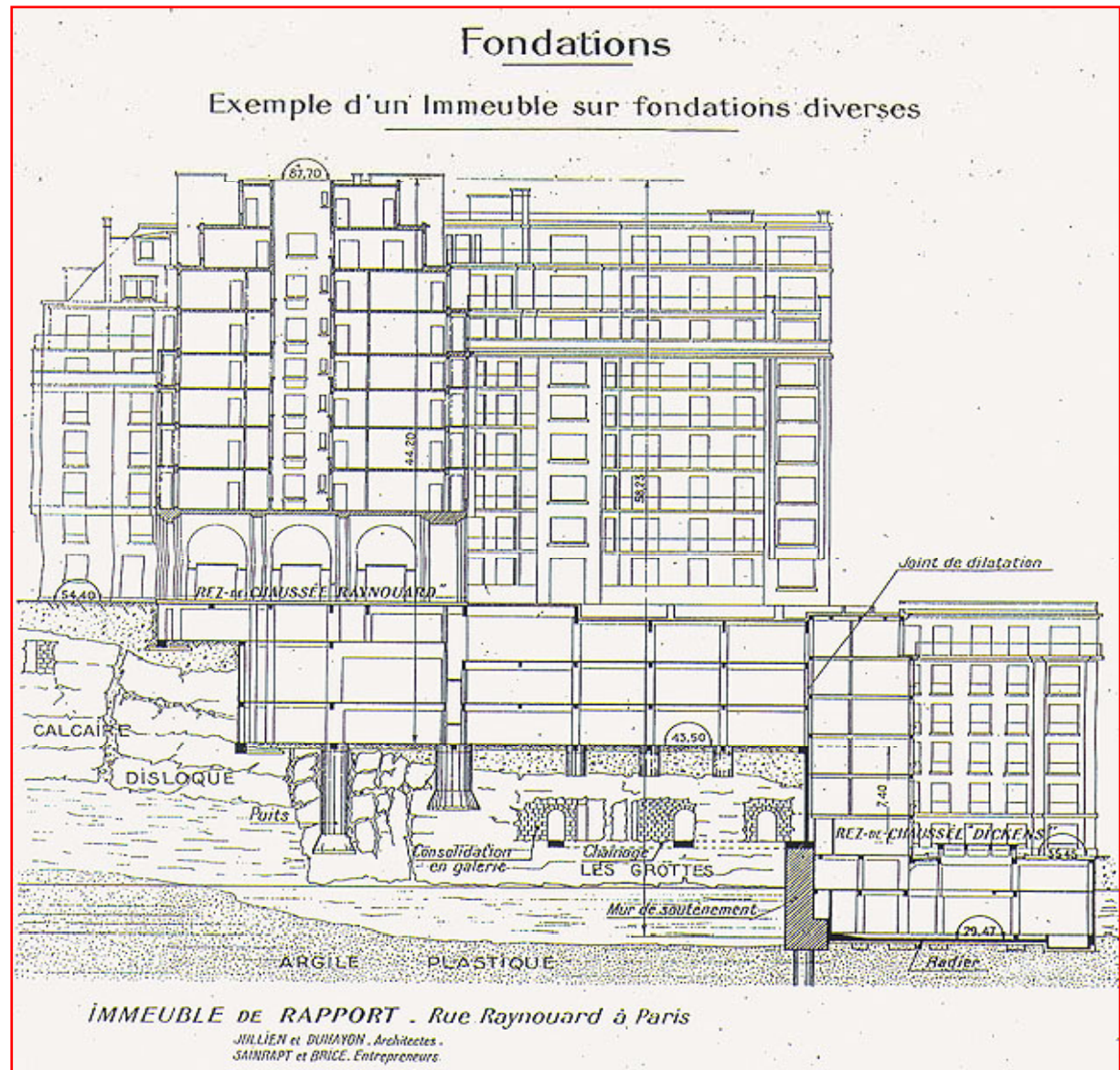
Location of Project



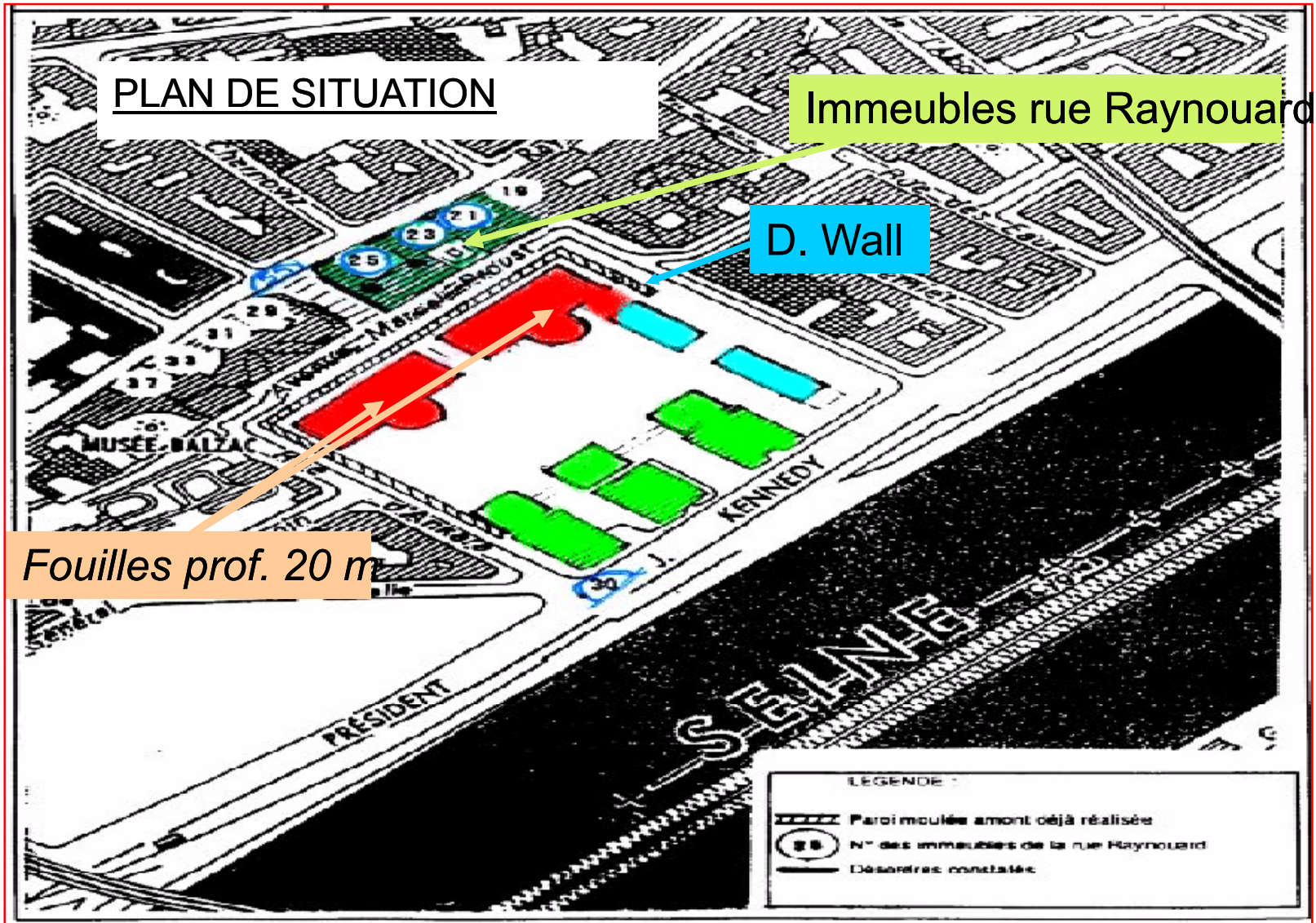
BACHY SOLETANCHE

# 21 / 25 Rue Raynouard - Paris 16ème - Existing Foundations

Typical section indicating the complexity of the existing foundations



# Rue Raynouard - Paris 16ème - Area of Failed Foundation



# Rue Raynouard - Paris 16ème - Temporary Support with Struts

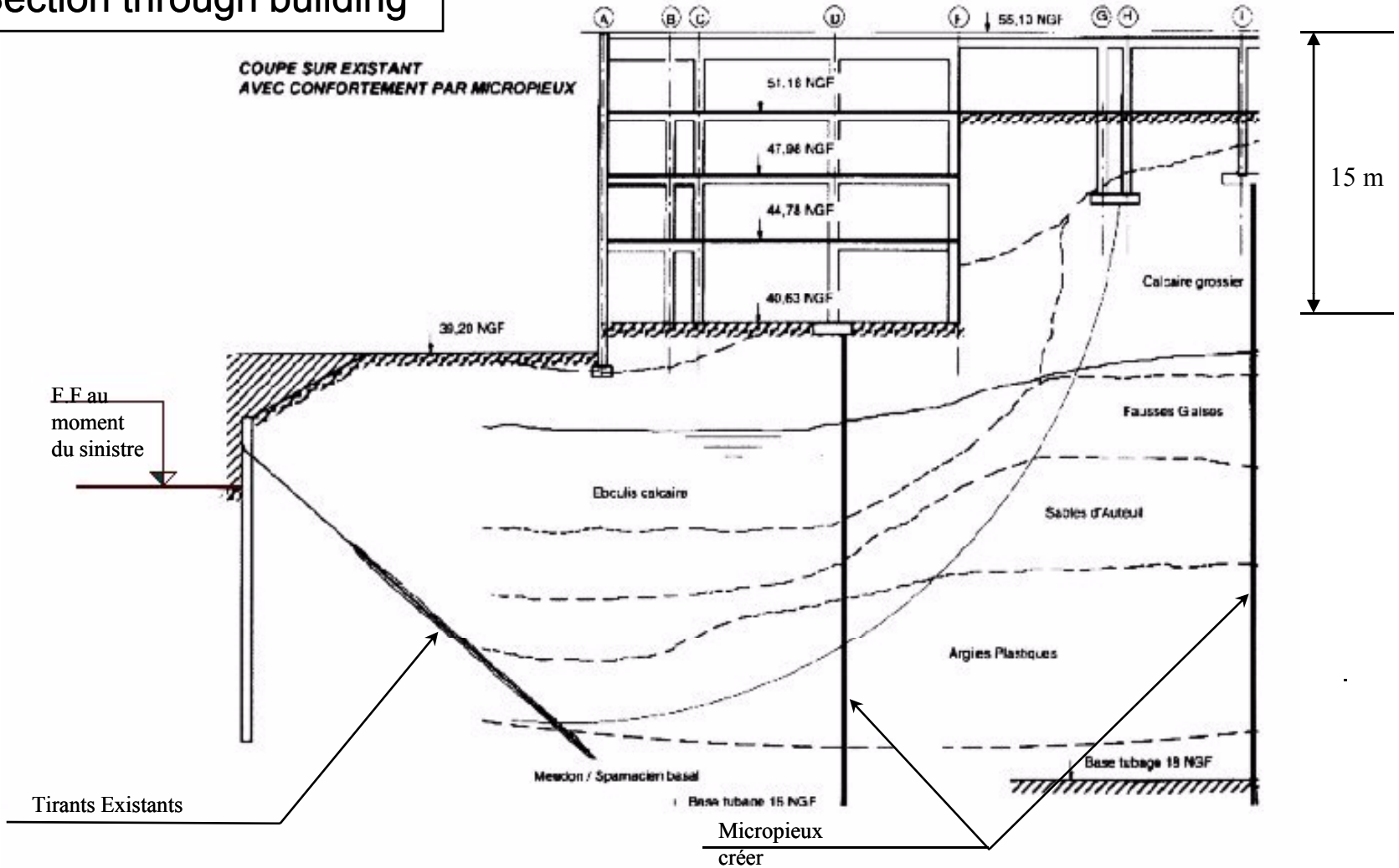


DETAIL AU DROIT DE LA PAROI EXISTANTE APRES SINISTRE

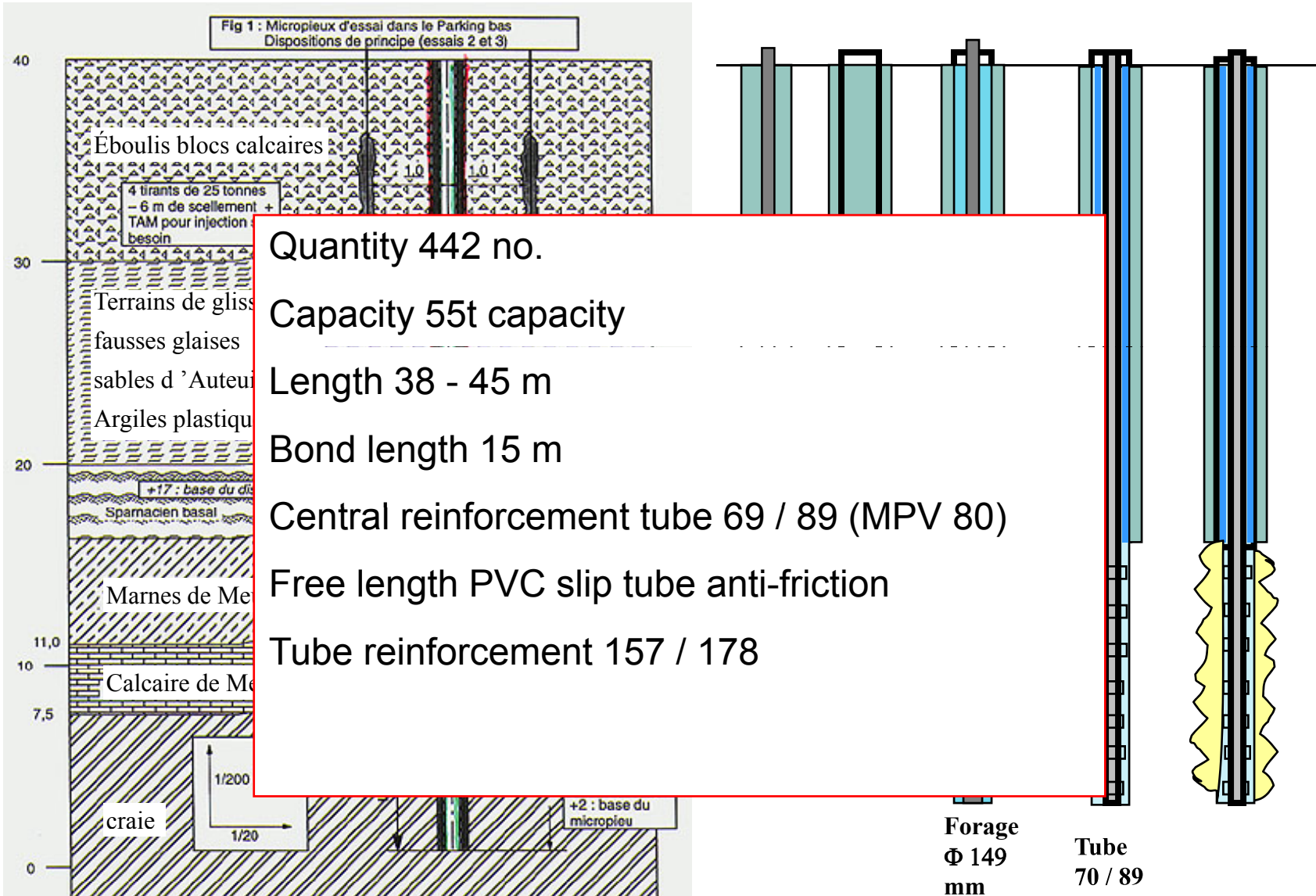


# 21 / 25 Rue Raynouard - Paris 16ème - D. Wall Slip Mechanism

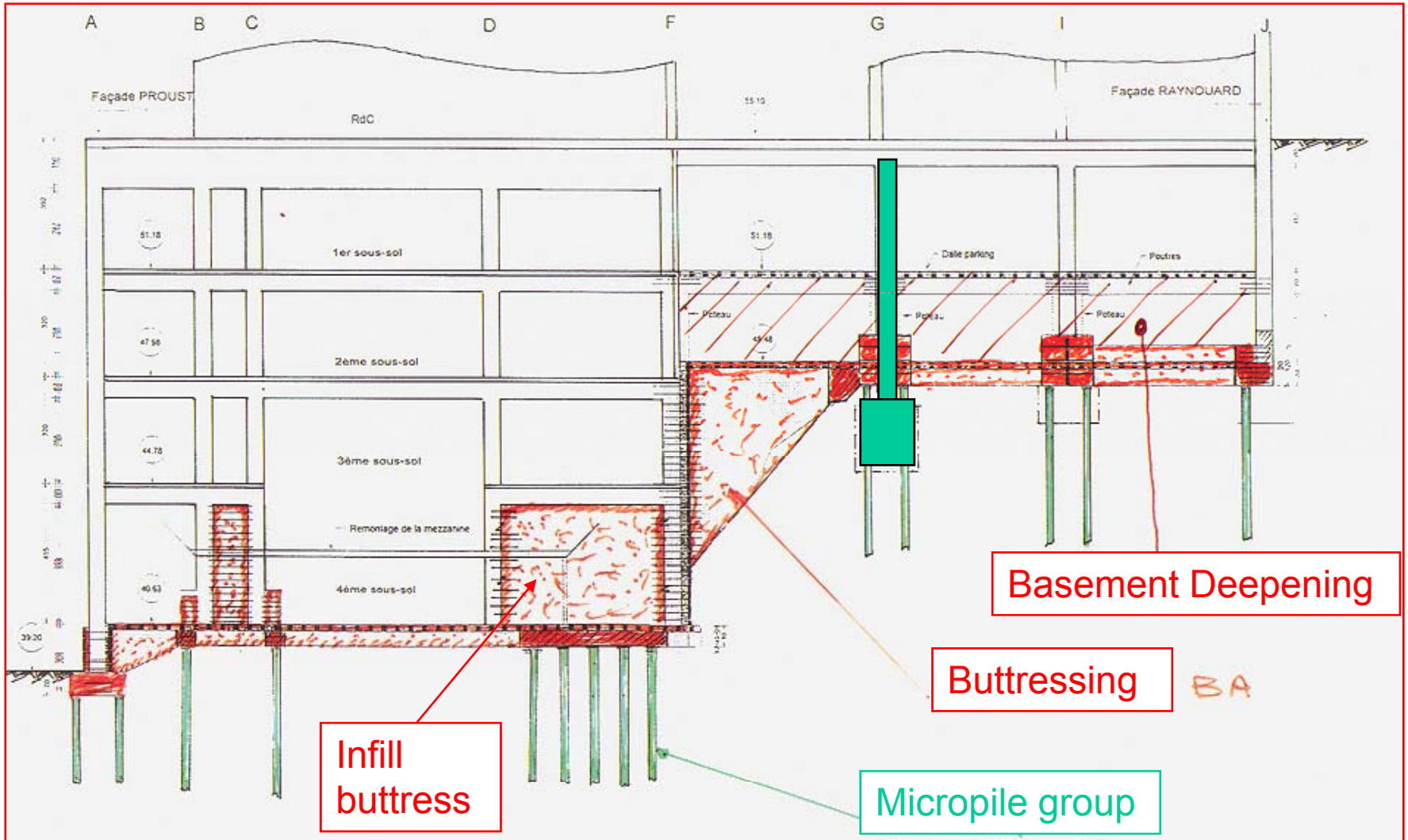
## Section through building



# 21 / 25 Rue Raynouard - Paris 16ème - Micropile Design



# 21 / 25 Rue Raynouard - Paris 16ème - Micropile Solution



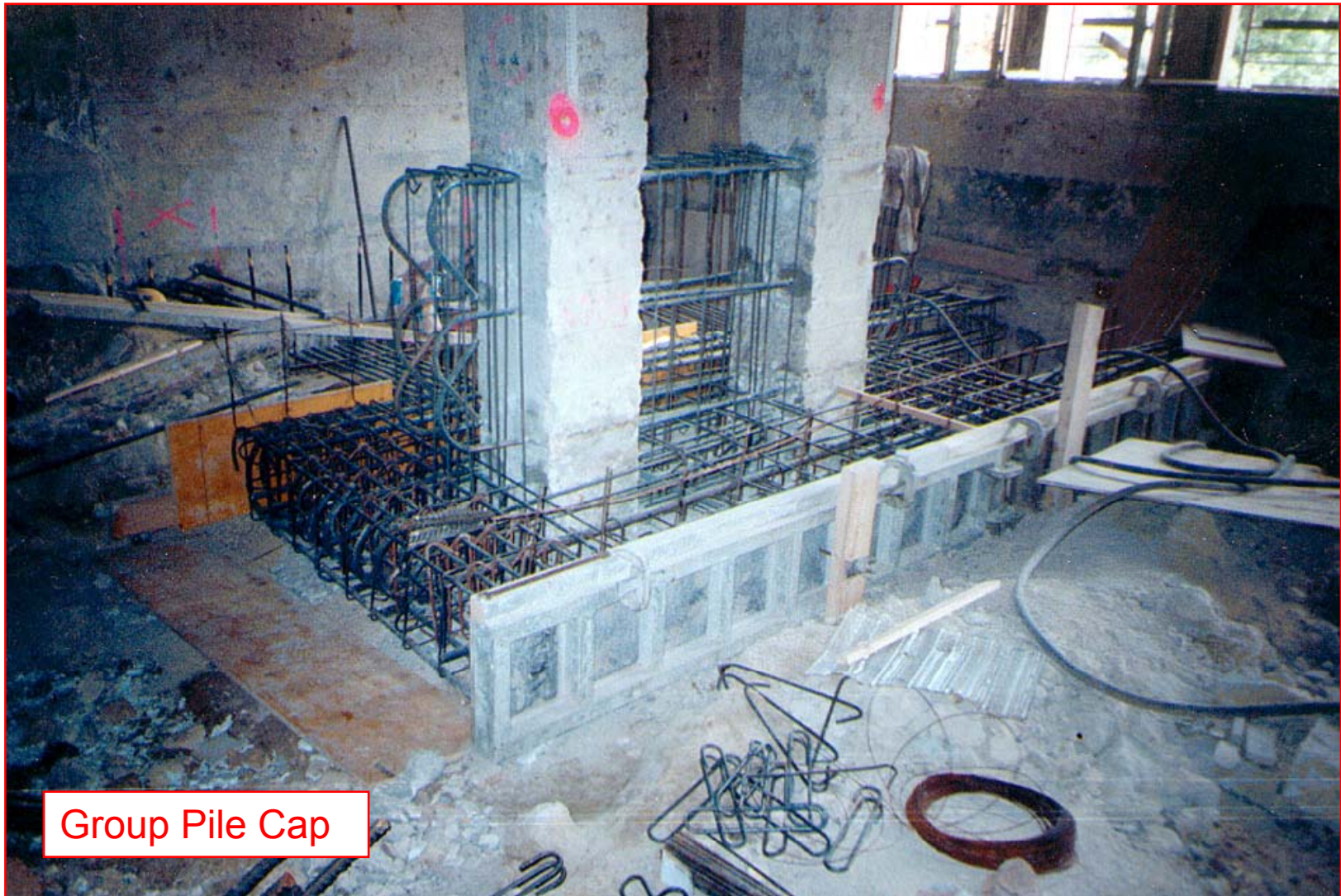
21 / 25 Rue Raynouard - Paris 16ème - Basement Drilling



21 / 25 Rue Raynouard - Paris 16ème - Installed Micropiles

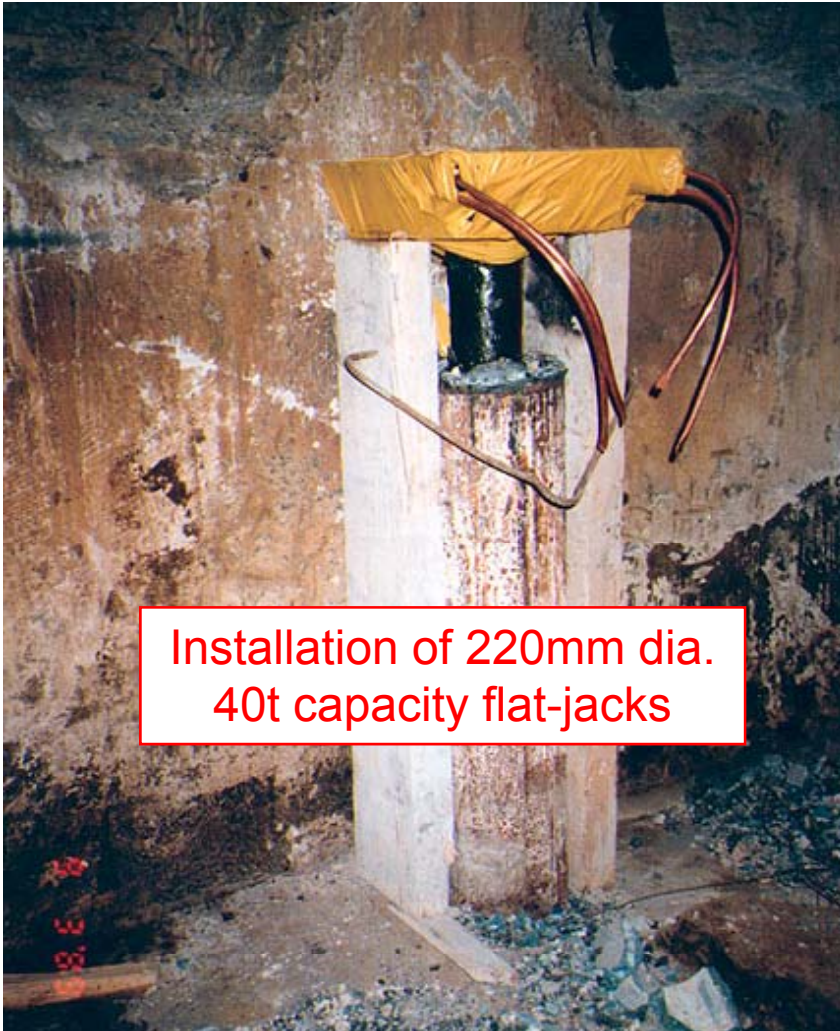


21 / 25 Rue Raynouard - Paris 16ème - Reinforcement Detail

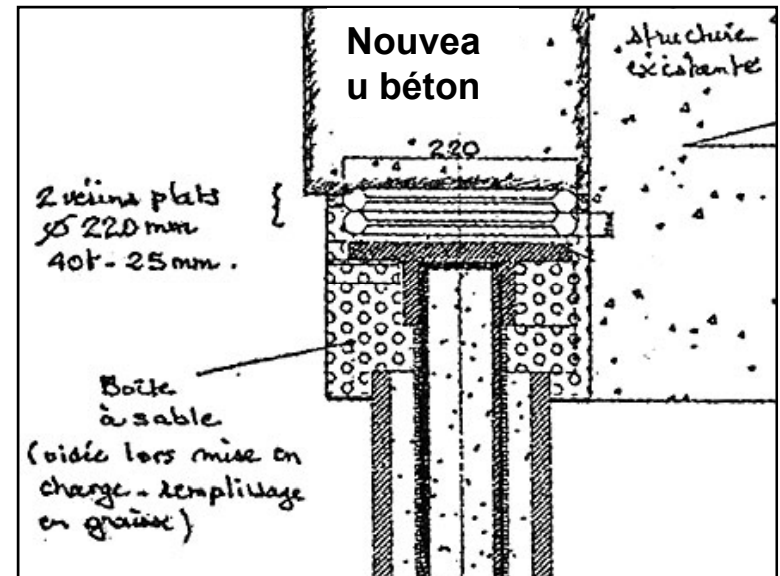


Group Pile Cap





Installation of 220mm dia. 40t capacity flat-jacks



# VIADUC DE GOURNAY

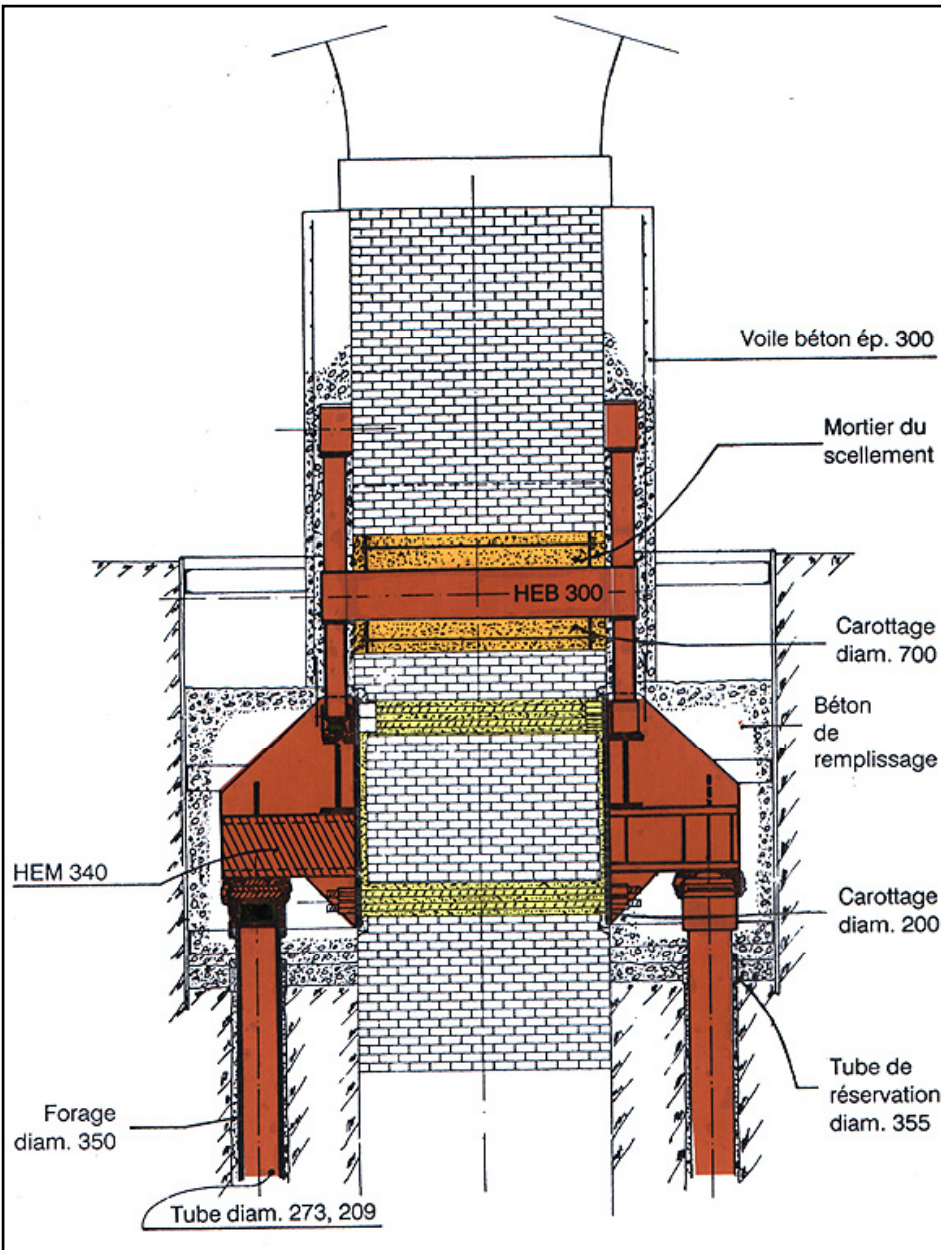
## Micropile Upgrade of Central Pier



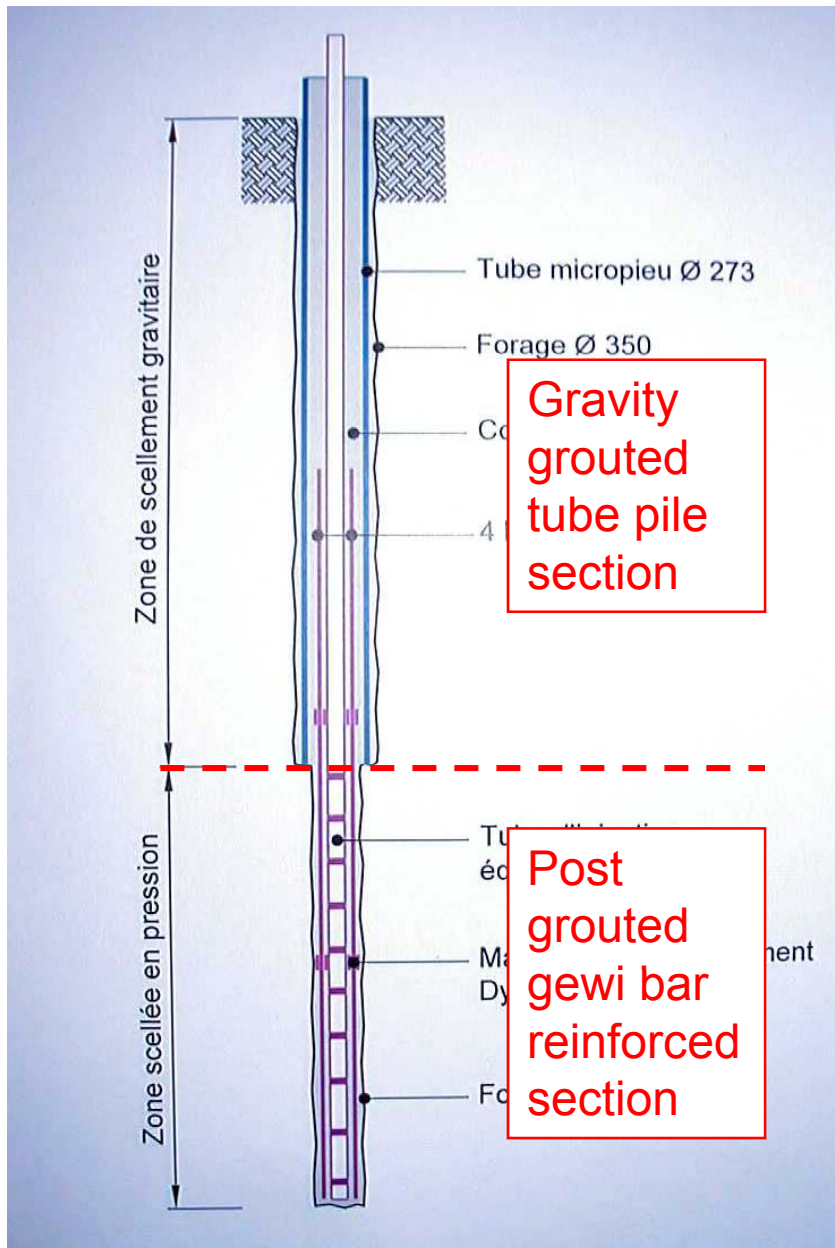


# VIADUC DE GOURNAY

## Steel Cradle and Micropiles



System of load transfer



# VIADUC DE GOURNAY

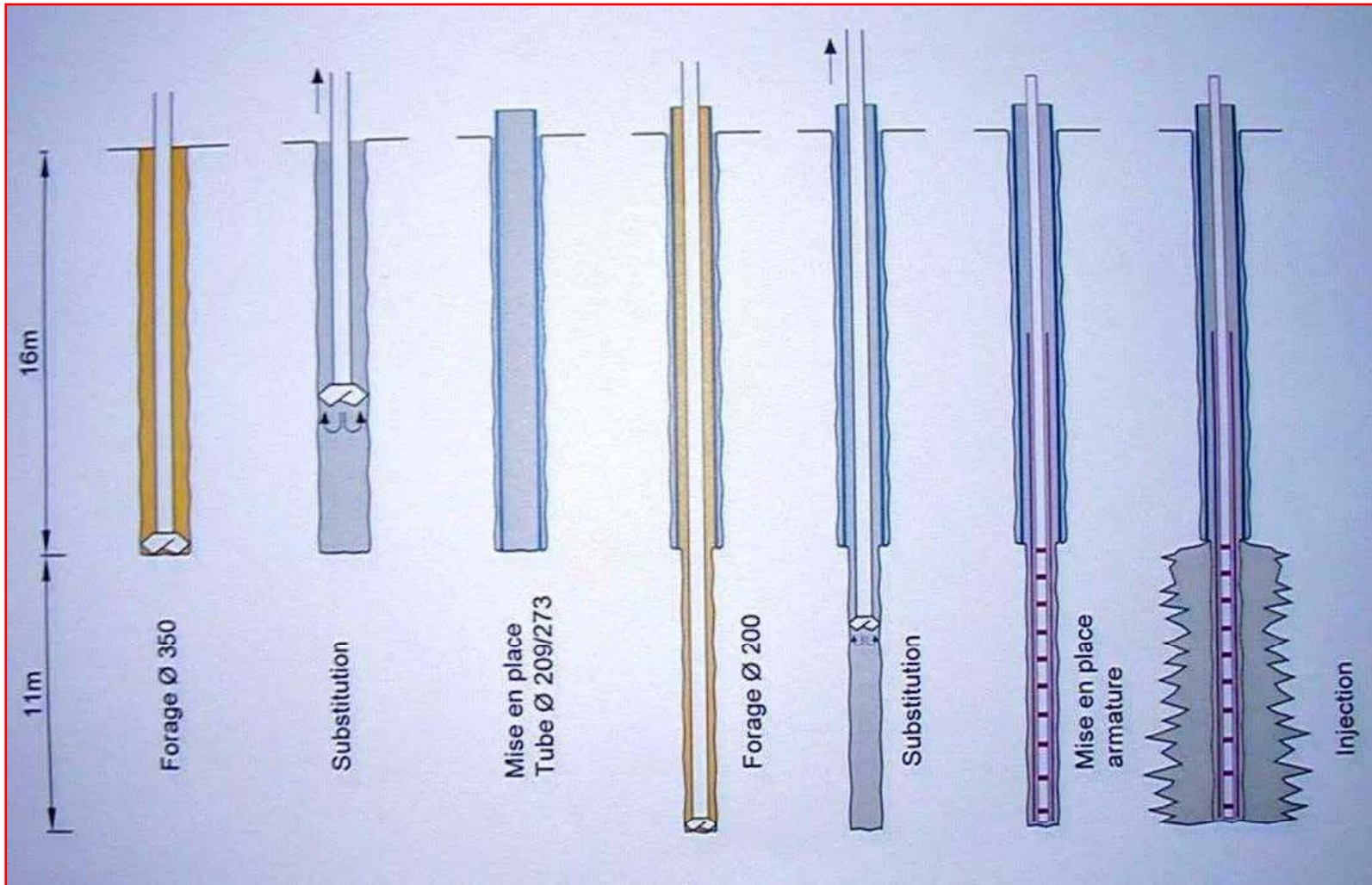
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## Installation of Piles

Steel tube micropile extended by TAM post grouting and Dywidag reinforcement

# VIADUC DE GOURNAY

## Pile Installation Sequence





# VIADUC DE GOURNAY - Installation of Piles

Drilling from trench prior to  
micropile installation

# VIADUC DE GOURNAY – Steel Tube Base Section of Micropile



Micropile tubes  
with full strength  
conical thread



# VIADUC DE GOURNAY

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## Placement of Reinforcement and Tube-à-Manchette

Installing bar cage  
reinforcement within the  
tube pile

# VIADUC DE GOURNAY

Steel TMD  
Tube-à-Manchette  
within bar cluster





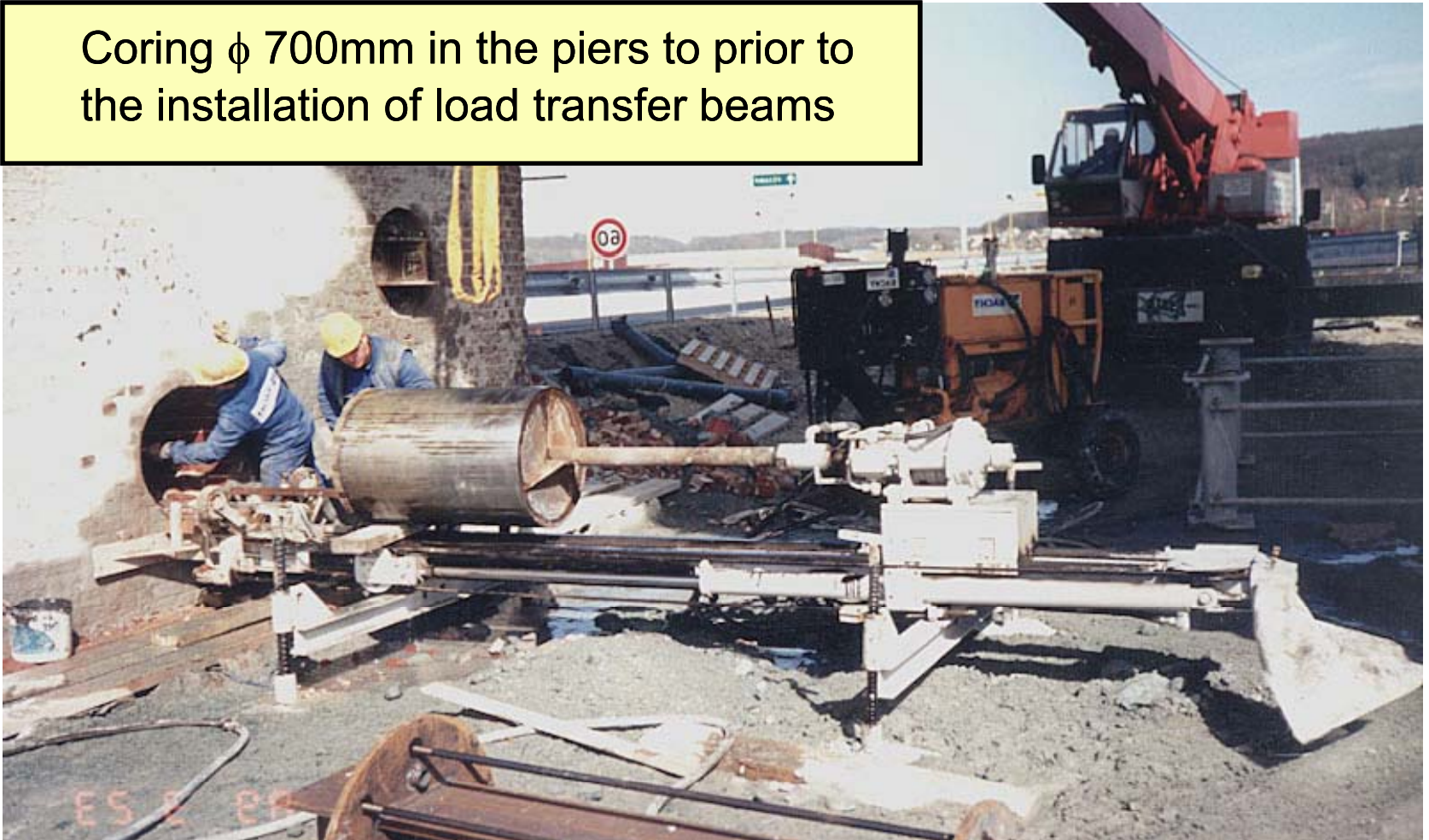
## VIADUC DE GOURNAY – Installed Micropiles

View showing the  
installed micropiles at  
cut off level



# VIADUC DE GOURNAY – Coring of Pier Walls

Coring  $\phi$  700mm in the piers to prior to the installation of load transfer beams



# VIADUC DE GOURNAY

## Core Drilling of pier



Extraction of core barrel with brickwork core intact

# VIADUC DE GOURNAY

## Core Drilling of pier



Interior view of core hole in brick pier

# VIADUC DE GOURNAY

## Installation of Load Transfer Beam





# VIADUC DE GOURNAY - Pile Installation

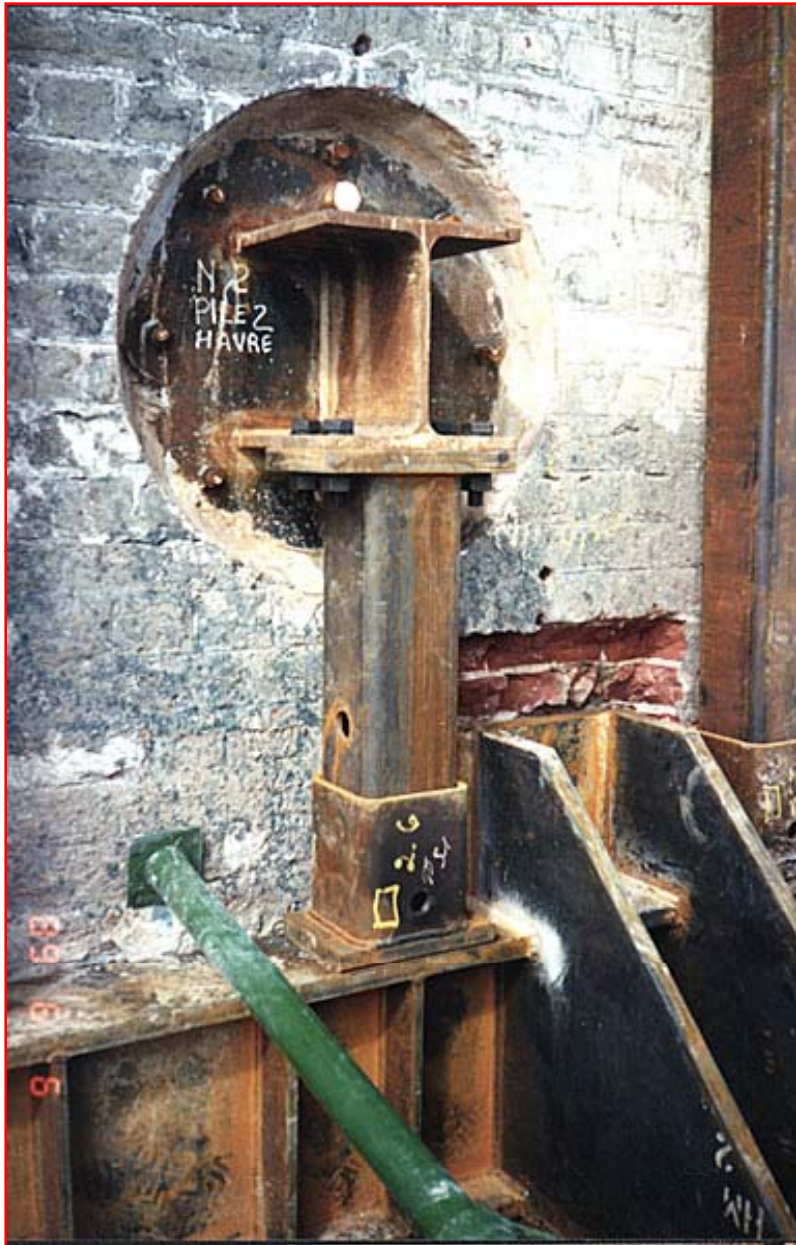
Installation of the lower steel  
section of the load transfer  
cradle onto the micropiles



# VIADUC DE GOURNAY - Pile Installation

Installation of the upper  
section of the load  
transfer cradle





# VIADUC DE GOURNAY - Pile Installation

Completed installation of the load transfer mechanism

# VIADUC DE GOURNAY - Pile Installation

Completed assembly after  
positioning and  
connection to structure







# VIADUC DE GOURNAY - Pile Installation

Preparatory works prior to casting  
a protective concrete cover  
around the completed assembly

# VIADUC DE GOURNAY – Completed Works

