CPR Morningside Grade Separation
ISM London 2009
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Physical Constraints

- U/S of Strut
- Limits of Shoring – 7.9 m
- U/S of Pile Cap
- Top of Aquifer
- To pq
- 6.7 m
- 6.4 m
Owner’s Specified Scheme:

324 Ø driven, closed-ended tube piles x 4m embedment

223 no. Driven Piles @ 535 kN SLS
Micropile Scheme:

52 Ø hollow bar micropiles x 5.7m embedment, installed using continuous grout flush

357 no. micropiles @ 365 kN SLS
The Pitch:

- Micropile materials in stock and ready for shipment to site
- Contractor to perform 5 load tests, including 2 pre-production
- Measurement for payment by lump sum, on a performance basis
Design Approach:

- Reduced individual pile loading
- Willingness to go closer to aquifer
- Load transfer into soil over entire embedment length

CONTINUOUS GROUT FLUSH
Resulting Design:

5.7 m embedment (commercially driven)

65 kN/m adhesion (carefully calculated risk taken by micropile contractor)

365 kN axial service compression per pile

Titan 52 hollow bar with 115 Ø drill bit; black, uncased
EL. 149.0 U/S of Footing

Titan 52/26 (Py = 730 kN)

EL. 149.0 U/S of Footing

Sand & Silt
- loose, grey, some clay, trace of gravel and cobbles

EL. 143.3 Tip of Micropile

Sand
- Some silt, very dense, trace of silt and gravel

EL. 142.3 Top of Aquifer
Load Testing:

• Total of 5 load tests – 2 at each abutment, 1 at centre pier

• Typical movements under static compressive loading to 100% : < 3mm

• Pre-production tension test performed to validate results of static compressive test
Benefits of using micropiles at this site:

• Reduced risk to aquifer

• Small equipment able to work comfortably in constricted space

• Off the shelf materials readily available

• Cost certainty from transferring measurement for payment from unit rate to lump sum

• Transfer of risk from owner to contractor via change to performance micropile contract from prescriptive driven pile design
Conclusions:

• Micropiles were a better foundation design for this project than driven piles.

• The switch to micropiles resulted in lower total foundation cost, but only because the micropile contractor was the micropile designer.
Hypothesis:

Although the use of micropiles at CPR Morningside was of immeasurable benefit to the owner, this project would be tendered no differently today.
223 no. Driven Tube Piles @ 535 kN SLS

5.7 m max. embedment @ 65 kN/m

365 kN SLS ..... 357 no. micropiles

5.7 m max. embedment

max. 40 kN/m ..... max. 230 kN per pile

> 500 no. Prescriptive designed piles
Hypothesis Confirmed:

Considering the absence of rock and the strict restriction on embedment depth, the owner could not possibly have gone to tender on micropiles because:

- Few to no local consulting engineers are able or willing to design it,
- Not more than one or two local micropile contractors are able to construct it, and ...
- Procurement via prescriptive design would have diverted the design away from micropiles due to high cost.
Thank you