Piling and Ground Engineering

Current and Future Technologies

Presented on the 3rd of December 2007 by Mr. Pat McCann

In association with the
Institution of Civil Engineering Surveyors
Institution of Civil Engineers
and Engineers Ireland
History of Cementation – 95 years

- Established in 1910 - Belgian Founder
- First contract in Ireland 1948
- Acquired by Trafalgar House in 1970
- Acquired by Skanska in November 2000
- Market leader in piling and ground engineering
Company Profile

- Internationally recognised specialist piling & ground engineering sub contracting company with annual T/O circa £75m
- Noted for technical excellence and performance
- Wide regional spread throughout the UK and Republic of Ireland
- Undertakes 150 contracts per annum - total workforce 500
- Owns extensive plant fleet with supporting workshop and manufacturing facilities
Certification

Environmental Management Systems
BS EN ISO 14001:1996 (LRQA)

Quality Management Systems
ISO 9001:2000 (LRQA)

Occupational Health and Safety Management Systems
OHSAS 18001:1999 (LRQA)
Bentley Works
Machine Shop
Manufacture of Piling Tools and Equipment
Bored Piles

Continuous Flight Auger

Rotary Mini-piles

Cementation Foundations

SKANSKA
Bored Piles

Continuous Flight Auger  Rotary  Mini-piles

Cementation Foundations

SKANSKA
- cement based grout injected at toe of pile to prestress pile base and enhance stiffness
- complicates/prolongs pile construction so can have some negative effects
- most effective at shallow depth
- consider whether excavation induced heave negates benefits of base grouting
Displacement Piles

Driven Precast  Driven Cast-in-situ  Bored Displacement

Cementation Foundations
SKANSKA
Bored Piles

Continuous Flight Auger

Rotary

Mini-piles

Drilling Fluids

- used to support unstable soils where casings cannot be used
- bentonite - forms a filter cake over pores
- polymers – long chain polymers clog pores
- storage requires space
• diameters 100mm to 600mm
• small equipment
Retaining Wall Types & Excavation Support Methods

Embedded Walls
- Contiguous Walls
  - Concrete Kingpost
- Secant Walls
  - Hard-Soft
  - Hard-Firm
  - Hard-Hard
- Diaphragm Walls
  - Grab
  - Hydromill
  - Movement joint

Other Methods
- Soil Nails
- Ground Anchors

Pre-cast guide wall & capping beam system
Contiguous bored pile wall

Hard / Soft

Hard / Firm

Hard / Hard

Diaphragm Walls
Contiguous bored pile wall

Embedded Walls
Contiguous Walls
Secant Walls
Diaphragm Walls
Powerscourt Hotel Wicklow

900mm Diameter Contiguous CFA Piled Wall Retained Height 14m
Diaphragm Walling Construction
Smithfield, Dublin

220m long x 90m wide x 10m deep
Spencer Dock
Slope Stabilisation – Dublin Airport

- Critical Grid Line 13
Anchors

Barrow Street - Dublin
– bar anchor ties.

Temporary strand anchors
Colmstock House
Concrete in Piles & Walls

- pile concrete specified to BS 8500
- piles & walls require high workability concrete mixes as compaction not possible
- high cementitious contents (>375kg/m³) with low w/c ratio
  PFA-OPC or GGBFS-OPC blends common
- admixtures (retarders & plasticisers) are common to reduce risk of segregation & ensure workability
- maximum aggregate size of 20mm may be reduced to 10mm if reinforcement density high
- minimum pile strength
  - \( f_{cu} = 20 \text{ N/mm}^2 \) for bearing piles with axial loading (BS8004)
  - \( f_{cu} \geq 30 \text{ N/mm}^2 \) for piles subject to flexure
  - higher minimum strength often required to satisfy durability (to BRE SD1)
- concrete strengths of \( f_{cu} = 35-40 \) are common with an upper limit of \( f_{cu} = 50\text{N/mm}^2 \)
- Hard-Firm primary pile mixes are generally low strength (\( f_{cu} = 5-10 \text{ N/mm}^2 @ 56 \text{ days} \)) to assist in achieving wall tolerances and not considered a structural. Durability to BRE SD1 generally limited to DS-1 or 2
Reinforcement & Connections

Reinforcement cages for piles & walls have to:

- comply with general rules for reinforcement design (e.g. BS8110 & BS5400) (provision of steel to limit flexural cracking can be problematic)
- be detailed to permit free flow of concrete between main bars and links to ensure durability
- be sufficiently rigid to withstand significant forces when being lifted or plunged into concrete
Reinforcement & Connections

- connections provided to capping beams do not normally require full anchorage – difficult to bend pile steel
- slab connections with couplers possible for diaphragm walls. Normally necessary to drill and fix starter bars with piled walls
- consider watertightness at joints between slabs & capping beams
- sealing of ground anchors in slabs and walls needs careful consideration
TESTING

• Maintained Load Testing
• Integrity Testing
• Dynamic Testing
• Concrete Cube Testing
• Concrete Slump Testing
Dundalk Water Treatment Plant
Typical Anchor Pile Test Arrangement
COMMERCIAL ASPECTS

- Typical attendances to be provided by others.
- Specification, Piling Contracts and Design liability
- Typical Problems (obstructions, standing time etc)
- Indicative Rates
Typical Attendances

- Setting out
- Spoil removal from rig and disposal.
- Pile trimming and provision for testing.
- Design information
Specification, Piling Contracts and Design Liability


• Contracts may be Nominated or Domestic.

• Design Liability depends on whether Client designed or Contractor designed.
Typical Problems

- Obstructions
- Standing time
- Testing
- Protection of works
- Attendance
Indicative Rates

- Precast driven 1
- Driven cast insitu 1
- CFA 1.25
- Rotary bored 1.5 – 2.5
- Rotary bored in rock 4 - 5
- Diaphragm wall €1000/sq m
LOOKING FORWARD

- New Technologies (increasing use of displacement piles and the contamination issue)
- Sustainability and Foundations (e.g. energy piles, materials selection)
- Consideration of Whole Life Costs (dealing with the requirements of PFI/PPP procurement processes)
QUESTIONS