Long term behavior of retaining walls in Dublin boulder clay

Mike Long

University College Dublin (UCD)
Heuston / Westgate

14 m high secant wall with single anchor
Ballycullen Road

7.5 m permanent cantilever
600 mm diameter contiguous piled wall
Anglo Irish Bank site – North Wall Quay

7.5 m cantilever secant piled wall

Inclinometer
Hammond Lane

4 m high cantilever wall immediately adjacent to LUAS railway line
Examples for Dublin Boulder Clay
Heuston / Westgate

IMMA masonry wall

Surcharge loading = 30 kPa

Ischebeck / Titan 73 / 53 bar at 2.25 m centres
Fixed length = 8.5 m

Dig level 0 mOD

900 mm diameter cfa hard / hard secant pile wall with piles at 1.4 mm centres
Pile toe level approx. -6 mOD.

SPT N (blows / 300 mm)

Elevation (mOD)

Limestone bedrock at -16 mOD

2005 GI

2000 GI
Dublin boulder clay

Material is very strong and stiff

Well graded (diamicton)
Very low permeability
Westgate – index testing

Water content (%) vs Elevation (mOD)

Plasticity index (%) vs Elevation (mOD)

Liquidity index vs Elevation (mOD)

UBrBC
UBkBC

2005 GI
2000 GI
Typical triaxial behavior - Heuston

High strength and stiffness
Strongly dilational
Effect of stress relief on pore pressure

Before excavation

- - - - -

z

Before excavation pore pressure, $u = \gamma_w \times z$

After excavation

Groundwater table at 2 m

After excavation stress relief reduces $u$ and it possibly becomes negative (i.e. suction)

Skempton $\Delta u = B[\Delta \sigma_3 + A(\Delta \sigma_1 - \Delta \sigma_3)]$
DPT – 12 m high soil nailed slope

Profile 1300W

Excavation period

Minimum reading = -6.9 kPa

Pore pressure (kPa)

1/9/02  10/12/02  20/3/03  28/6/03  6/10/03  14/1/04

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Westgate – wall movement v depth

Lateral wall movement (mm)

UBrBC
UBkBC

Elevation (mOD)

Limestone bedrock at -16 mOD

27/8/2007
14/2/2013
Wall movement v time

Lateral wall movement (mm)

Time (Years)

Accuracy?

Elevation +9.5 m

14/9/11 23/12/11 1/4/12 10/7/12 18/10/12 26/1/13 6/5/13 14/8/13 22/11/13 2/3/14 10/6/14
Ballycullen Rd.

- 0.6 m diameter water pipe
- 600 mm diameter contiguous piles at 750 mm centres
- Basement slab reduces max. retained height to 6.3 m in long term
- Dig level +99.5 mOD (7.5 m retained height) in temporary case

Graph showing SPT N (blows / 300 mm) vs Elevation (mOD): Made ground, UBrBC, UBkBC
Ballycullen Rd. - wall movements

- Retained height = 6.3 m in long term (7.5 m in short term)

Graph showing lateral wall movement (mm) and maximum lateral wall displacement (mm) over time (years).
Challenge

Can we model this situation adequately with a "simple model" (PLAXIS HSM does not work - it cannot capture the rate of dilation)