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Case Study - Broomhouse

Utilising CPT To Value Engineer Foundation Solutions

Background

GE Solutions Consulting Ltd (GES) were engaged by Ground Developments Ltd (GDL) on behalf of Miller Homes / Taylor Wimpey to prepare a foundation engineering strategy for their development at Broomhouse, Glasgow. The site is adjacent to the M73 on the eastern periphery of Glasgow and is a multiphase development which has been on-going for a number of years at the time of writing. The development was approaching the final phasing in Pods 5, 6 & 7 which approaches the M73. The area of concern was a conjectured made ground area that traverses a portion of Pods 5, 6 & 7 which was believed to be material arising from the construction of the M73 construction in the early 1970s and thus is well consolidated over many decades.

The primary geotechnical interpretative reporting (Johnston, Poole & Bloomer (JPB) Ground Investigation Report for Pods 5 to 8, August 2017) indicates the following:

The investigation has indicated that the east and west of the site is overlain by made ground. Due to the inherent variability of this material it is considered that this horizon would not be very suitable as a founding horizon in its present condition.

It was further suggested that where made ground is not disturbed, vibro techniques or piling may be suitable, however a definitive recommendation was not made. It was therefore assumed when preparing the initial foundation zoning plans for the clients that without further testing, the plots in the main would be piled with a smaller number identified for trenchfill.

GES undertook a campaign of cone penetration testing in order to provide definitive foundation solutions for the site. Using a customised Geomil Panther rig equipped with 15cm2 piezocones the testing comprised 46nr probes which measured tip resistance, sleeve friction and porewater pressure. In conceptual terms the number of probes undertaken was just over one per every two plots, thus is a very intensive suite of testing to provide definitive profiling for the area under consideration.

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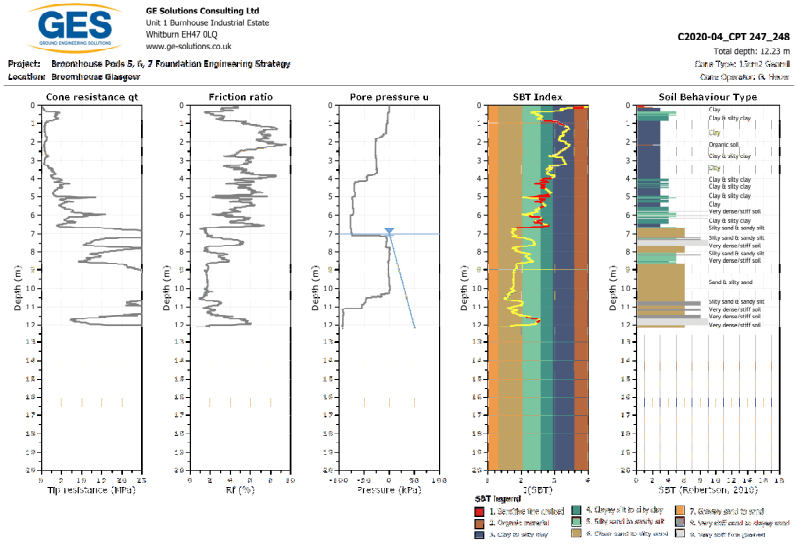
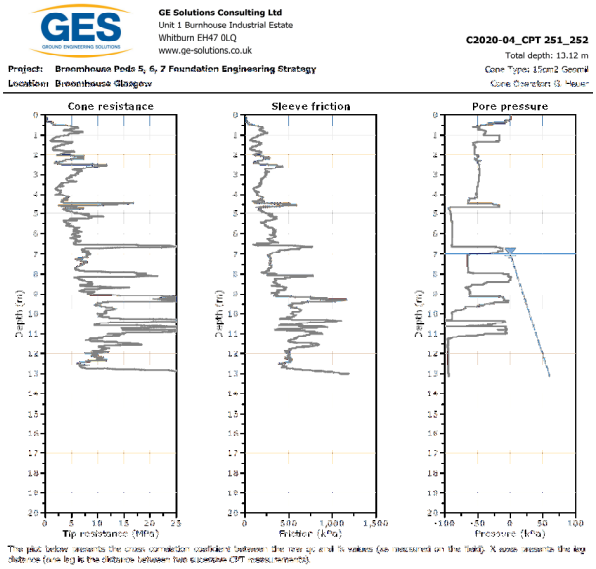
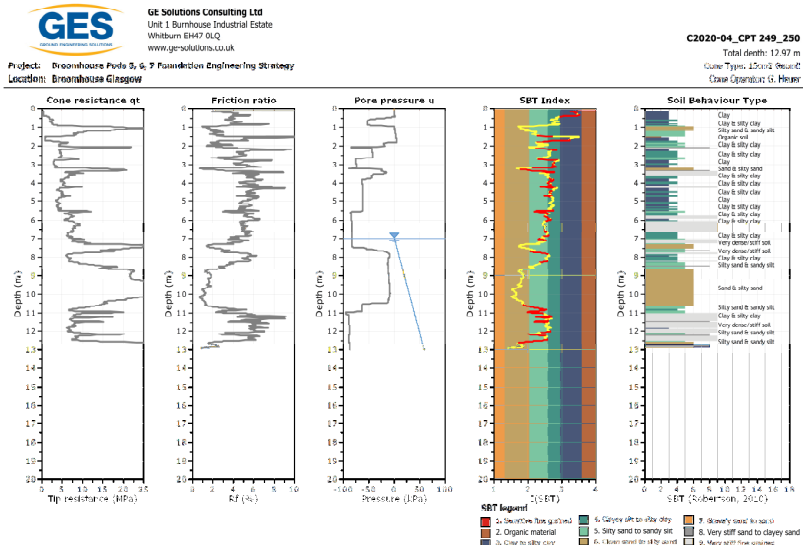
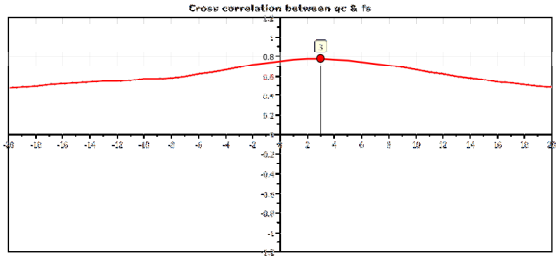
Example CPT Results









Zone	Estimated ultimate bearing capacity (kN/m²)	Estimated primary consolidation settlement (mm)	Estimated secondary consolidation settlement (mm)	Total long-term settlement (mm)	Proposed foundation system	Notes
1	551.8	30	18	48	Vibro replacement columns	Settlement governing
2	390.3	25	34	59	Piles	Excessive secondary compression
3	567.4	17	23	40	Vibro replacement columns	Settlement governing
4	476.7	20	20	40	Vibro replacement columns	Settlement governing
5	540.5	24	20	44	Vibro replacement columns	Settlement governing

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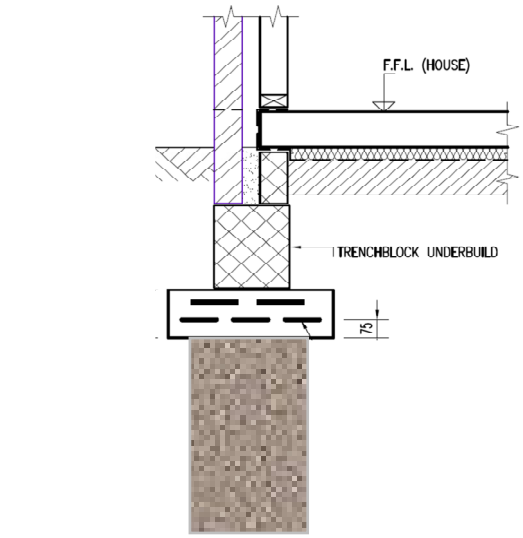
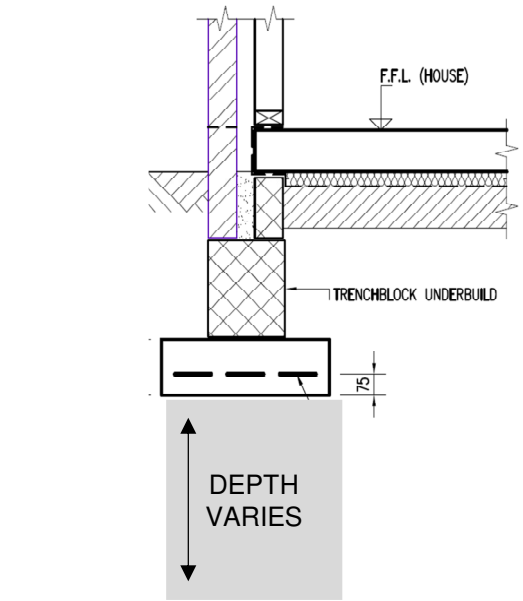
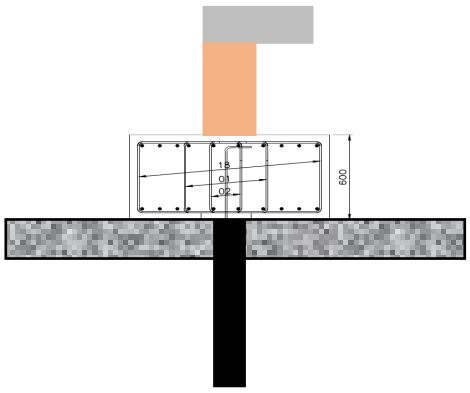
Cost Benefit







GDL Vibro Solution

The layout of the vibro stone columns are arranged to suit the specific application.

Typically the vibro will be performed off a stabilised piling mat at a cost of around £440 per plot.

The vibro price will vary dependant on plot size:

- Smaller semi detached/terraced = £1,500 - £2,000 per plot
- Larger detached with detached double garages = £4,500 per plot

= £2,000 - £5,000 a plot

Mass fill Concrete

- Excess material generated
- Certainty issue
- Quality after a certain depth an issue

Potentially viable, base on 2.5m depth

Area top of foundation 24m2 x 2.5m depth = 60m3

Exc £9m3
Disposal off–site £20m3
T/Fill Concrete £150
All in rate £179m3

£179 x 90m3

= £10,740 a plot

Driven Piling & Ground Beams

The piling rig will require a thick stone piling platform, typically 500mm thick, which would cost around £1,500 per plot.

The cost of driven piling including ground beams = £12,000 - £15,000 per plot

= £13,500 – £16,500 a plot

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Result

Plots Converted to Vibro Stone Columns	=	75
Estimated Cost Saving	=	£565k
Less Cost of CPT Testing & Reporting	=	£9k
Overall Cost Saving	**=**	**£556k**

In Summary:

Cone Penetration Testing (CPT) to prove vibro stone columns can be used as an alternative to piling and deep trench fill can bring Significant Savings

For more information contact:
Ground Developments Ltd
Telephone : 01506 884405
Email: info@grounddevelopments.co.uk