



RBL WEBINAR

Ground Improvement:

Unlocking RBL's Value Engineering Capabilities



ROGER BULLIVANT

roger-bullivant.co.uk

✉ info@roger-bullivant.co.uk

☎ 01332 977300

in [@rogerbullivantlimited](https://www.linkedin.com/company/rogerbullivantlimited)

RBL'S PRESENTERS



Andrew Wandless

Ground Improvement Manager



Dan Tayler

Ground Improvement Manager



Megan Goodchild

Marketing Manager

WHAT ARE WE COVERING?

01 Our Business

02 Sustainability

03 RBL's Value Engineering Capabilities

a) Case study - Bidfood

b) Case study – Longbridge

06 Summary

07 Q&A



ROGER BULLIVANT LIMITED

AT A GLANCE

Total employees.

500+

Linear metres of precast beam
manufactured annually.

>250,000 LM

Providing piling and foundation
solutions in the residential sector.

Residential

RBL has the capacity to
manufacture over 1 million metres
of precast pile every year.

1M

Fleet of piling rigs.

50+

100% of precast products manufactured
with low carbon concrete.

100%

Providing piling and foundation
solutions for various commercial projects.

Commercial

OUR PRODUCTS

WHAT WE DO

PILING



- Driven Precast Concrete Piles
- Driven Steel Tubular Piles
- RB Combipile
- Continuous Helical Displacement Piles (CHD)
- Continuous Displacement Auger Piles (CDA)
- Continuous Helical Auger Displacement Piles (CHAD)
- Continuous Flight Auger Piles (CFA)
- Contiguous Piled Retaining Walls

GROUND IMPROVEMENT



- Vibro Stone Columns
- Rigid Inclusions

FOUNDATION SYSTEMS



- RBeam Precast Concrete Ground Beams
- Precast Caps

RESTRICTED ACCESS



- Sectional Flight Auger (SFA)
- Bottom Driven Minipiles
- Overburden Drilling System
- Jack Piles & Jack Pile Raft
- Grundomat Piles
- Drill Bar Piles
- Underpinning

LOCAL KNOWLEDGE NATIONAL SUPPORT



THINK FOR A SECOND PUT SAFETY FIRST



Sustainability



**TO REDUCE OUR
CARBON FOOTPRINT
BY 40% BY 2030**



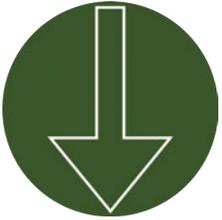
Low Carbon Concrete

Reduced cement content by 50% by replacing it with recycled material.



Displacement Pile Solutions

Generates minimal spoil reducing number of lorry movements, lowering carbon emissions.



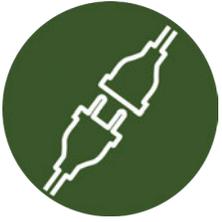
Continuous Helical Displacement (CHD) Piles

Offer shorter pile lengths, therefore reducing concrete usage and associated carbon emissions.



PV Panels

PV panels installed on HQ and precast manufacturing facility.



Electric Forklift Fleet at HQ

Electric trucks can save an average of 679,805 kilograms of CO₂ a year.



HVO Fuel

RBL now only supplies HVO fuel to power its bulk tanks and rigs, as well as onsite forklift trucks.



Supporting the National Forest

RBL supports improvements at Albert Village Lake and the Princess Diana Memorial Woodlands, near its HQ.



Electric Piling Rigs

First in the UK to trial the Junttan PMX2e fully battery powered driven piling rig to provide carbon savings on existing projects.

RBL's Value Engineering Capabilities



Case Study: Bidfood CHD x RI





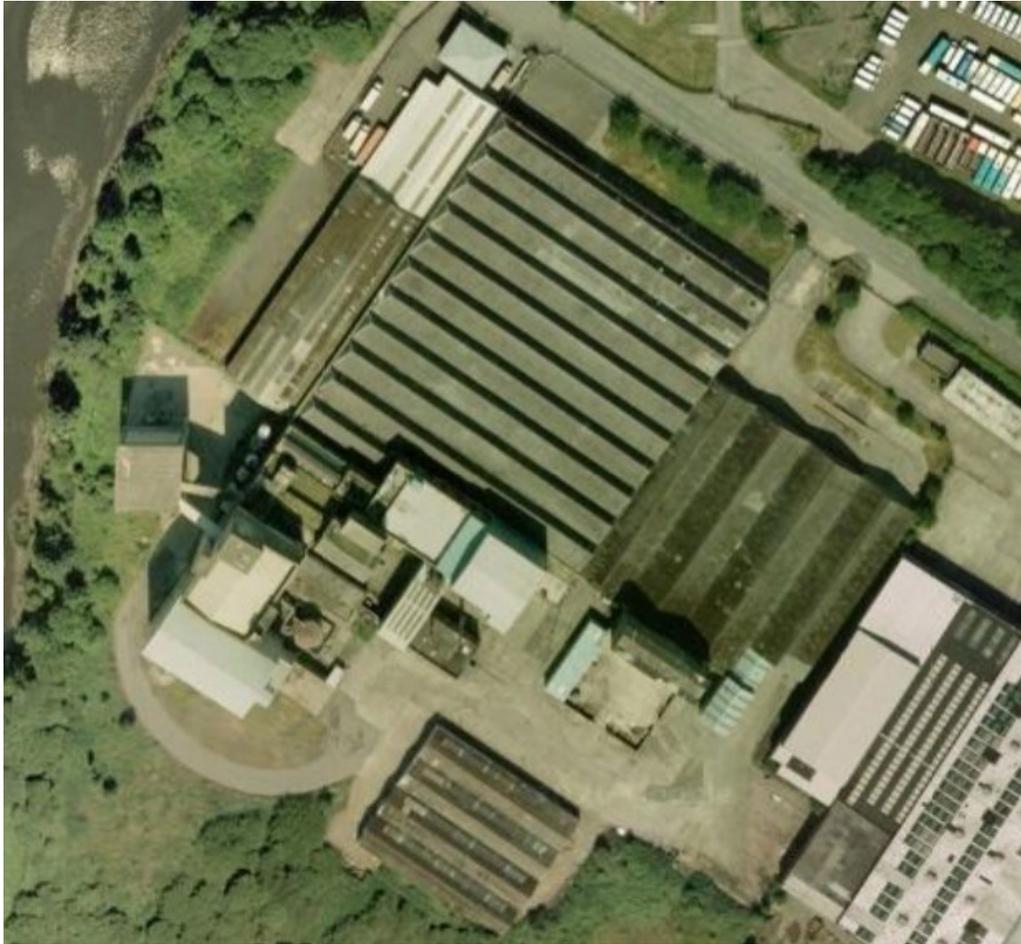
Bidfood, Renfrew Rigid Inclusions x CHD Piles

Key issues/requirements

- Historic foundations
- Site regrade
- Variable soils
- Variable foundation depth
- Airport flight path

Project Solution

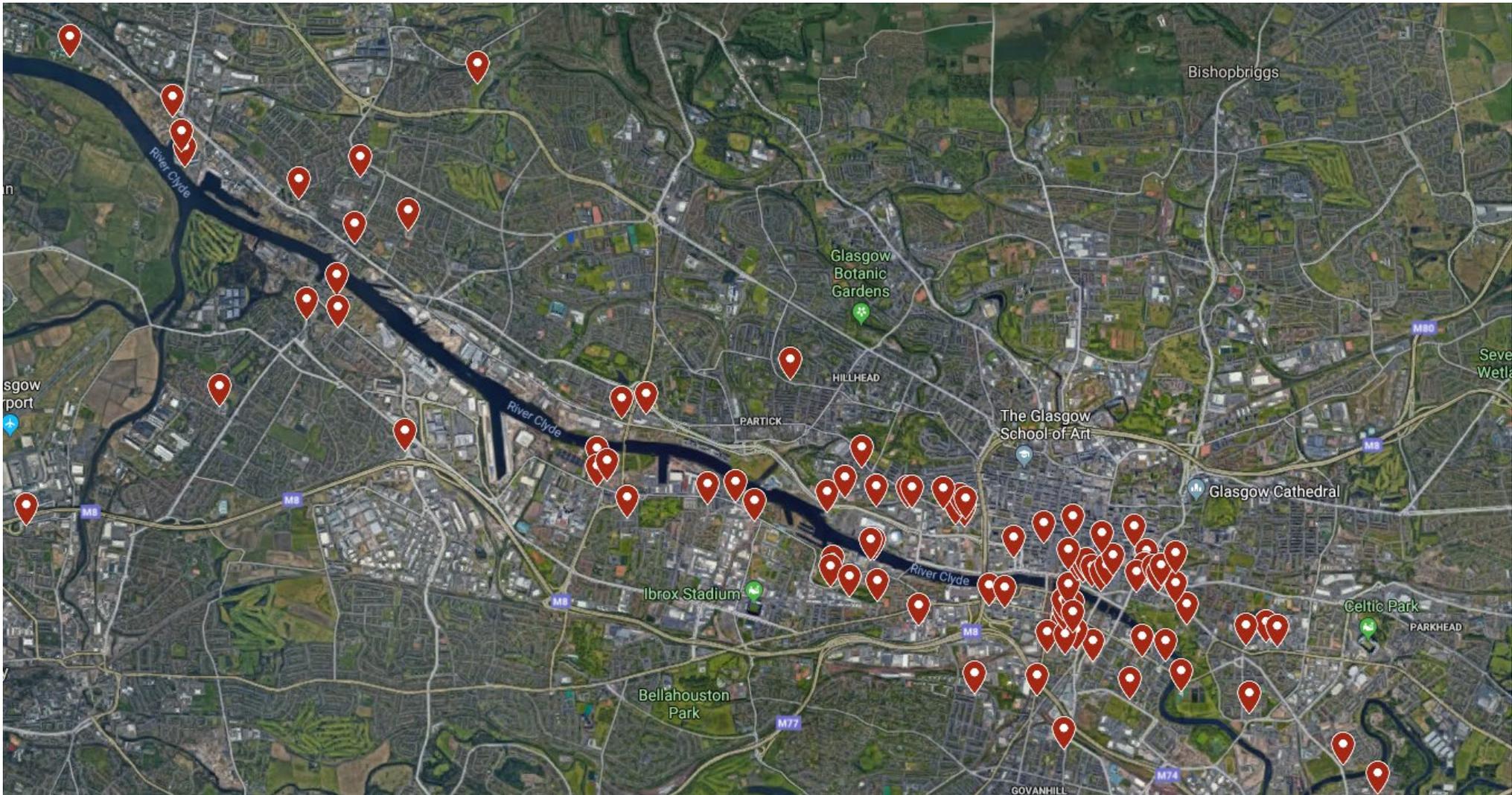
- Remediation of historic foundations.
- Localised Bespoke designs.
- Incorporating WP into LTP
- CHD Piled beneath frame
- RI Ground Improvement beneath slab



*Arial Image – Google Earth
Pre-2008*



*Arial Image – Google Earth
Post-2008*



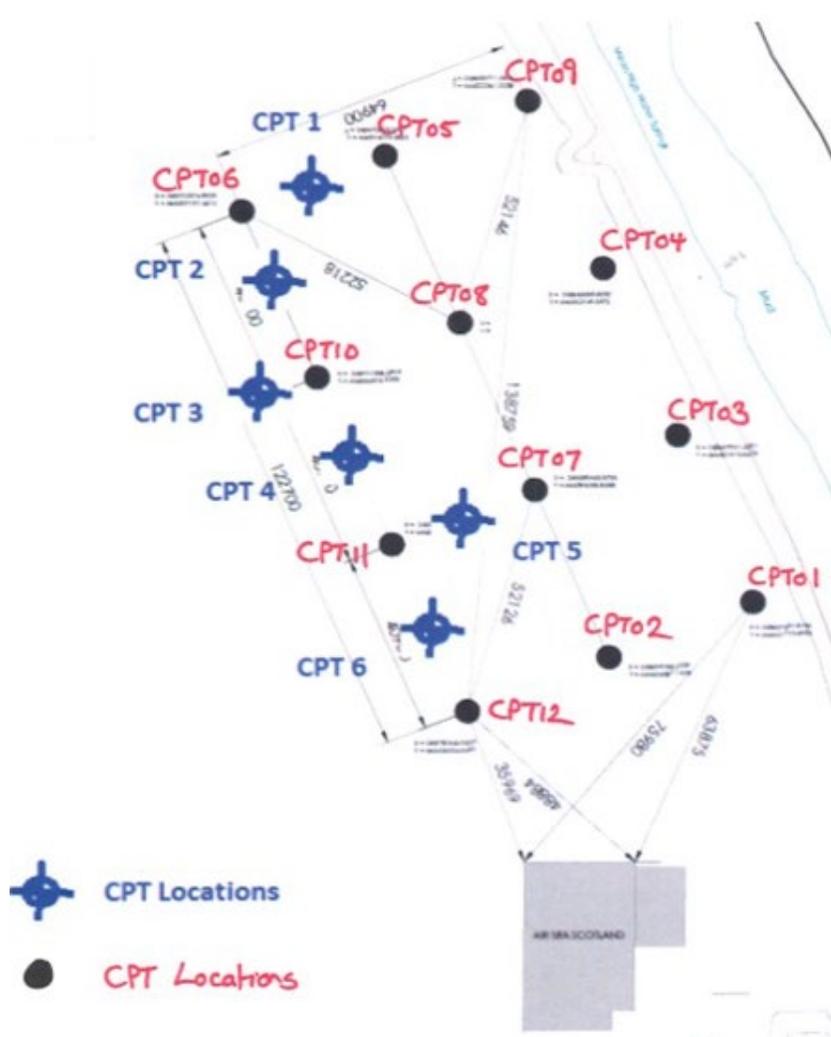
Completed Displacement Piling Projects



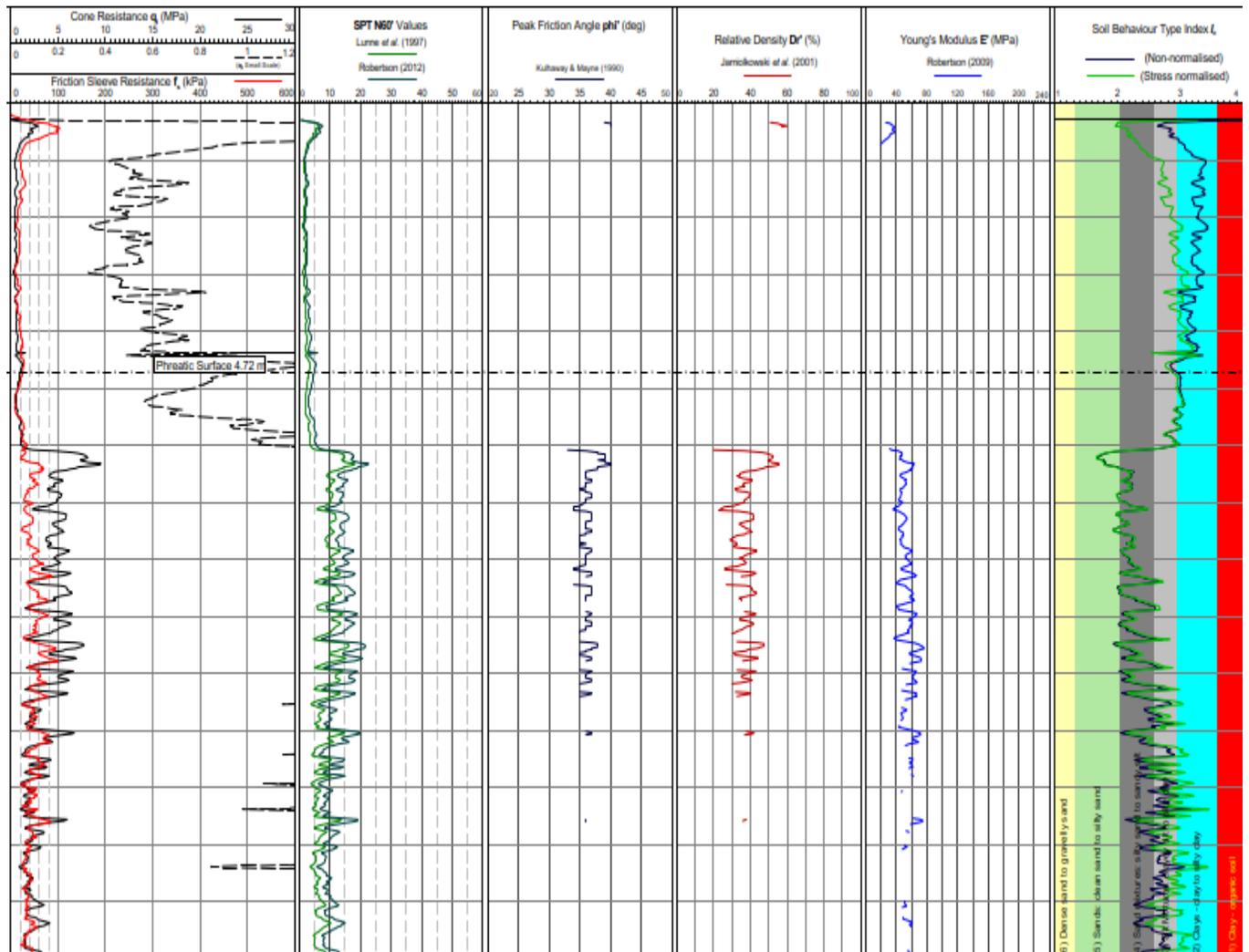
Original Site Investigation Layout
 EnviroCentre Limited Report (Ref: 8828)

DUNELM GEO-TECHNICAL & ENVIRONMENTAL			BOREHOLE RECORD			Borehole BH04	
Contract No: S1027			Site: Wright Street, Renfrew			GL (m AOD) Scale 1:50	
Client: EnviroCentre			Driller: MH		Logged By: STM		Sheet 1 of 1
Method: Cable Percussive Boring			Checked By: KES		Dates: 29/07/2019		
SAMPLE DETAILS			Depth (m)	Level (m AOD)	Legend	Well/ Backfill	
Type	Depth From-To (m)	In situ Testing					
D	0.50						
ES	0.50						
D	1.00						
ES	1.00						
D	1.20						
SPT (S)	1.20 - 1.85	N=5 (1,0/1,1,2)	(1.20) Dry				
D	2.00						
SPT (S)	2.00 - 2.45	N=5 (1,1/1,2,1)	(2.00) Dry				
D	3.00						
SPT (S)	3.00 - 3.45	N=4 (1,1/1,1,1)	(3.00) Dry				
D	4.00						
SPT (S)	4.00 - 4.45	N=6 (1,0/1,2,1,2)	(4.00) Dry				
D	5.00						
SPT (S)	5.00 - 5.45	N=4 (2,1/0,1,1,2)	(5.00) Dry				
D	6.00						
ES	6.00						
			End of Borehole at 6.00 m				

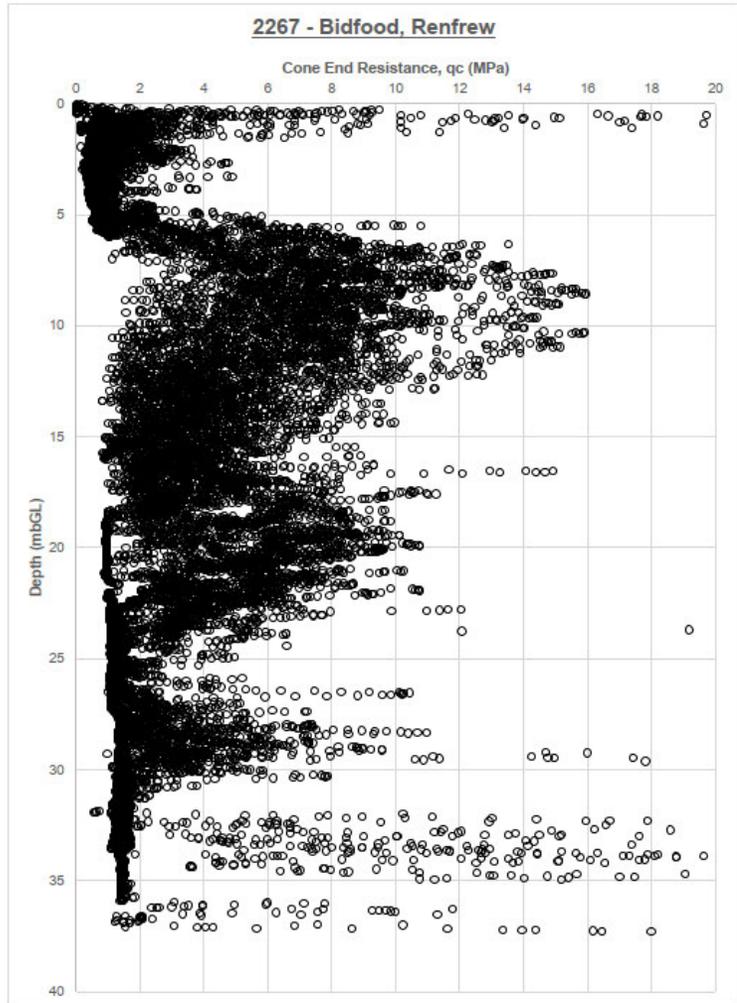
Example Borehole
 EnviroCentre Limited Report (Ref: 8828)



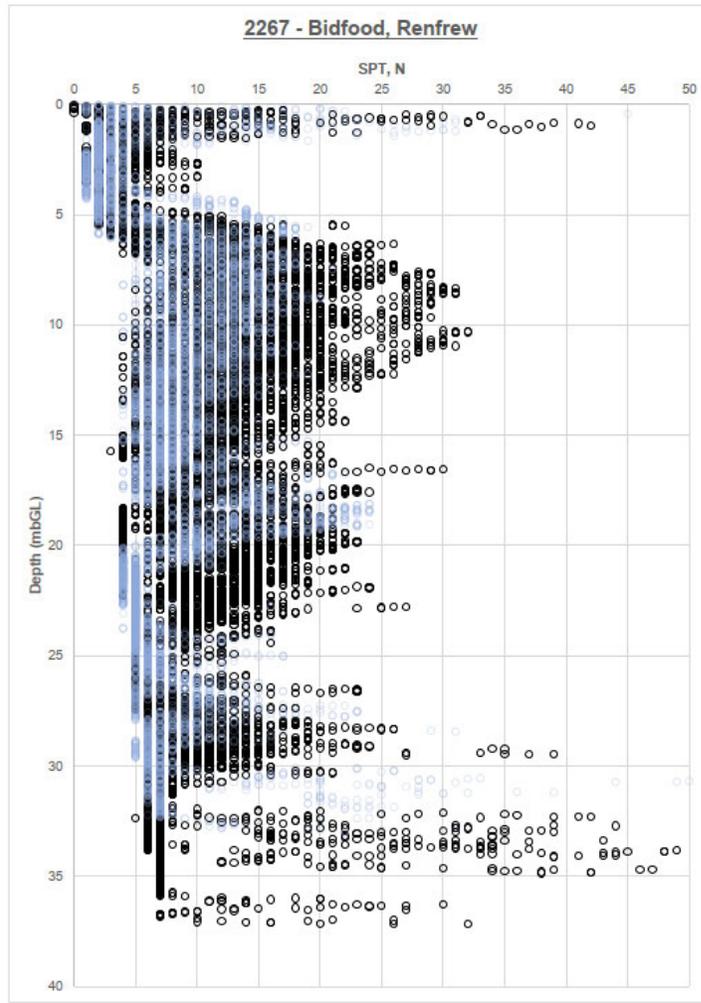
Additional Site Investigation Layout
Lankelma Report (Ref: P-107635-1)



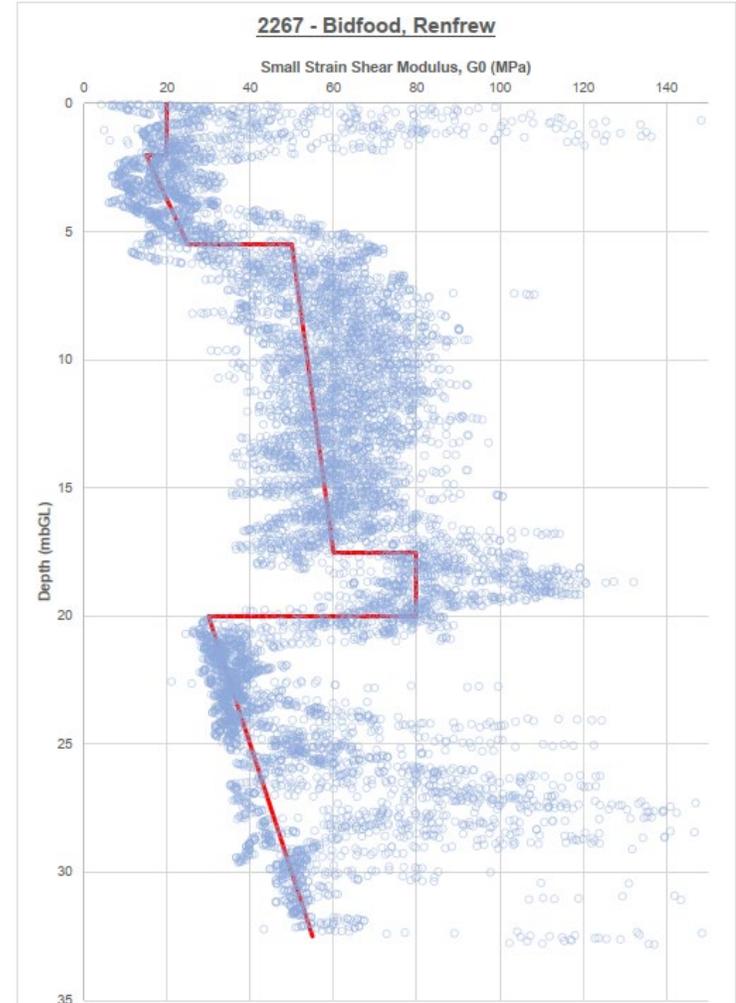
Example Cone Penetration Test (CPT)
Lankelma Report (Ref: P-107635-1)



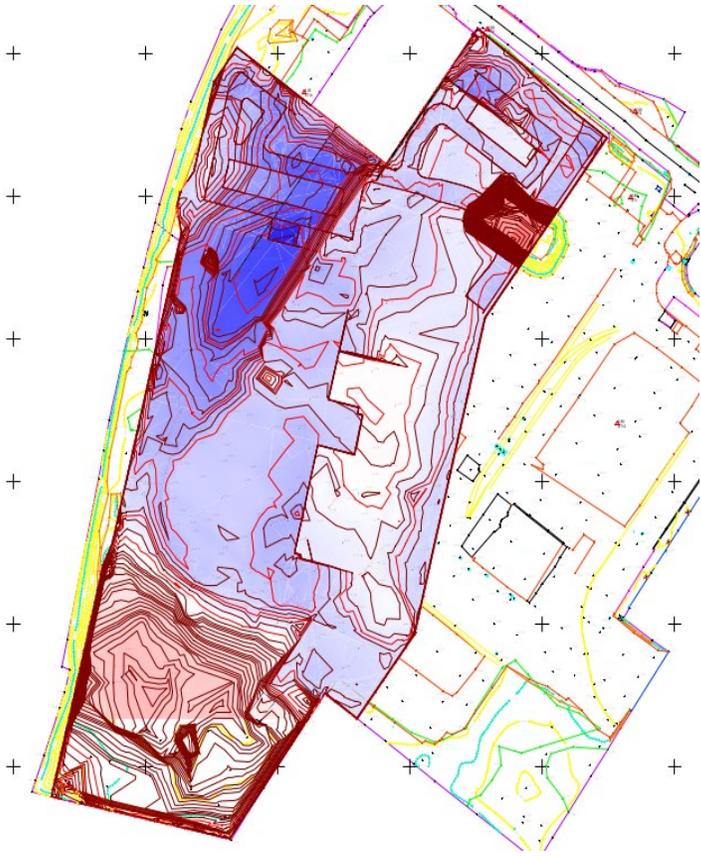
Plotted Cone End Resistances (qc)



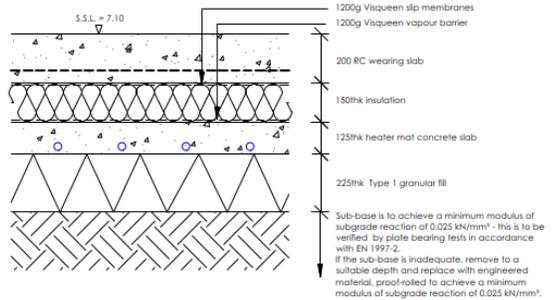
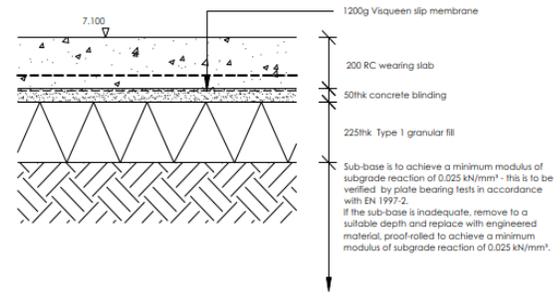
Standard Penetration Tests (Blows - N)



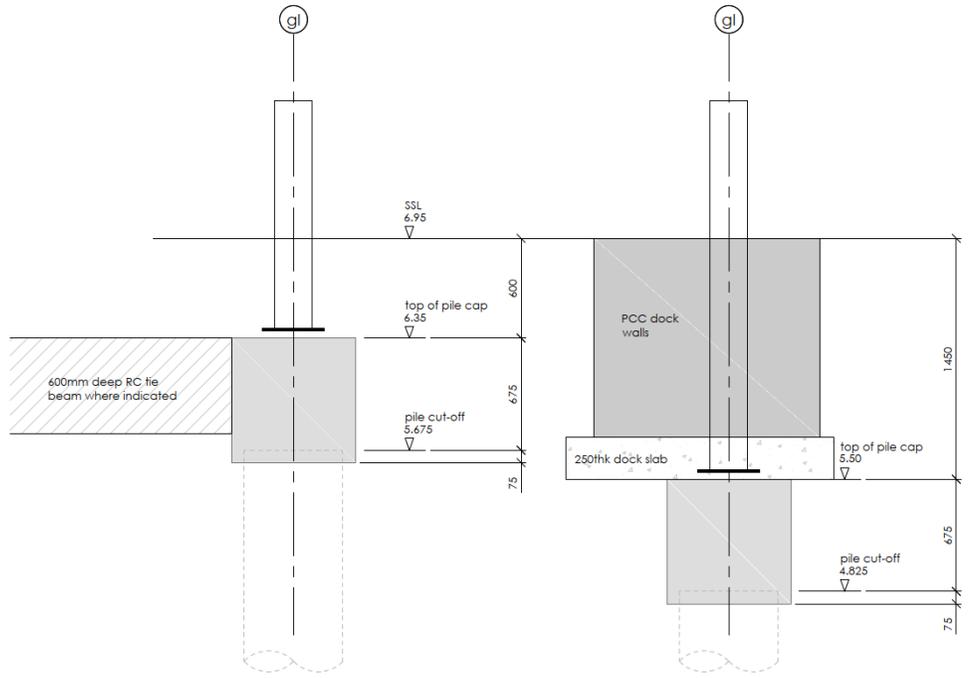
Small Strain Shear Modulus (Go)



Site Regrade Topographic



Typical Cross-Section of Slab Foundations



Cross-Section - Pile Cap with CHD

VALUE ENGINEERING APPROACH

Engineers Specification	RBL Proposal
<p>Frame: 600mm dia CFA Piles Compression (max) – 350kN Tension (Max): 10kN Lateral (Max): 75kN</p>	<p>Frame: 300/600mm dia CHD Piles from 8.0 – 16.0m Compression (max) – 350kN Lateral: 50kN Diameter: 400/700mm Lateral(Max): 75kN</p>
<p>Internal Floor Slab: 600mm dia Vibro Stone Column ABP: 60kN/m² Total settlement: <25mm</p>	<p>Internal Floor Slab: 300mm dia Rigid Inclusion (RI) Length: 6.0-8.0m Load Transfer Platform: 400mm Spacing: 1.75m² to 3.0m² ABP: 9kN/m² to 68kN/m² Total settlement: <30mm</p>

RIGID INCLUSIONS

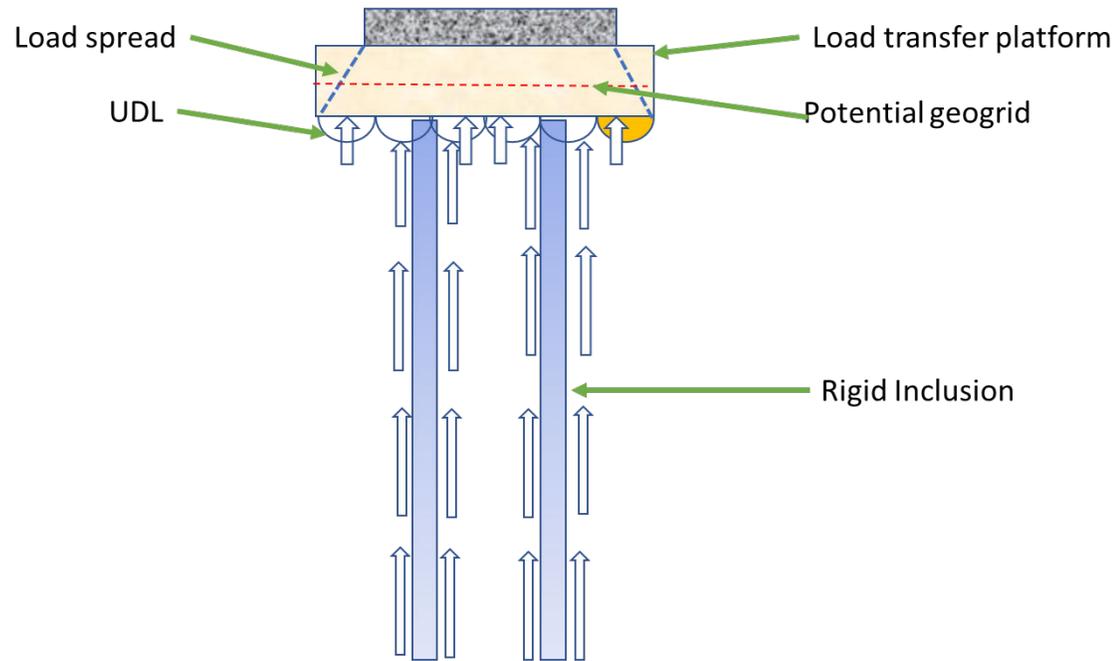
(RI)

Vertical inclusions of unreinforced concrete in a helical formation with a solid central core.

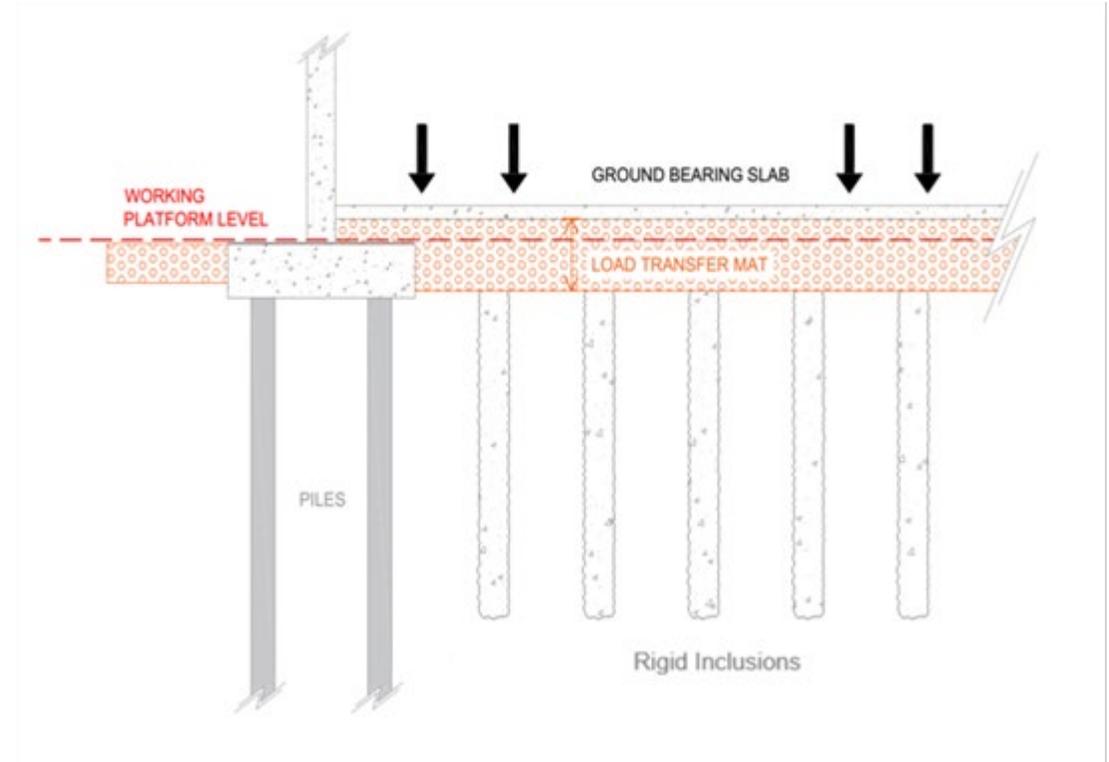
- Intended to Improved composite modulus of soil / inclusion through volume replacement.
- As part of the design process a balance of negative, positive skin friction resistances and end bearing (Neutral plane)
- Load transference by a pre-determined thickness of platform (LTP) to ensure proportionate distribution of load between RI and intermediate soil.



RIGID INCLUSIONS (RI)

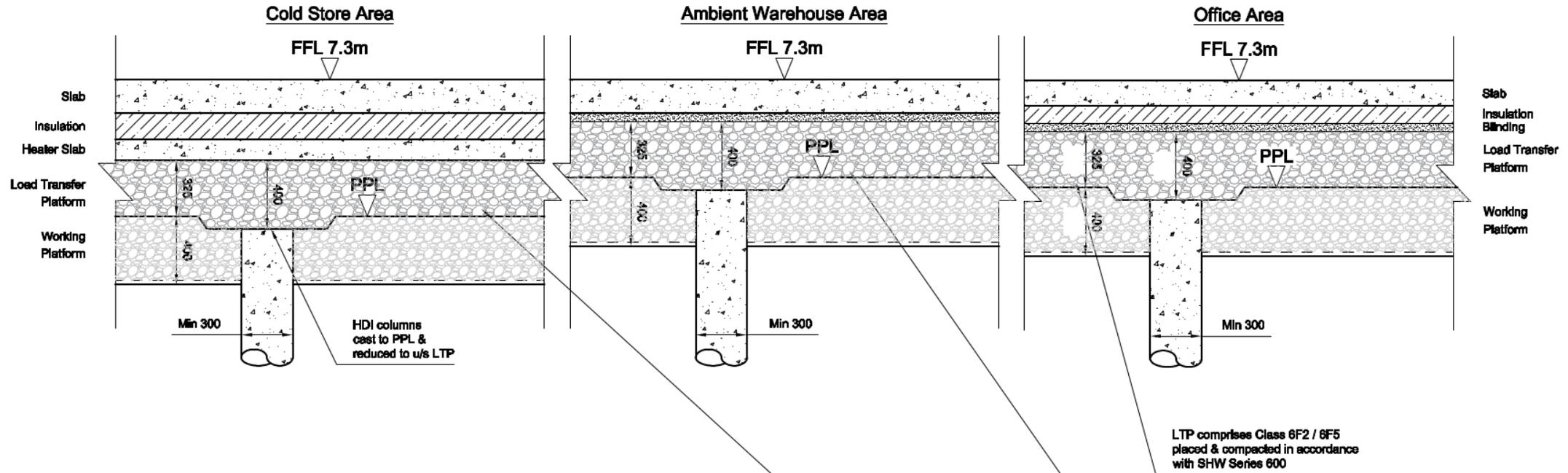


RI Functionality



Typical Cross-Section of RI / CHD foundations

RIGID INCLUSIONS (RI)



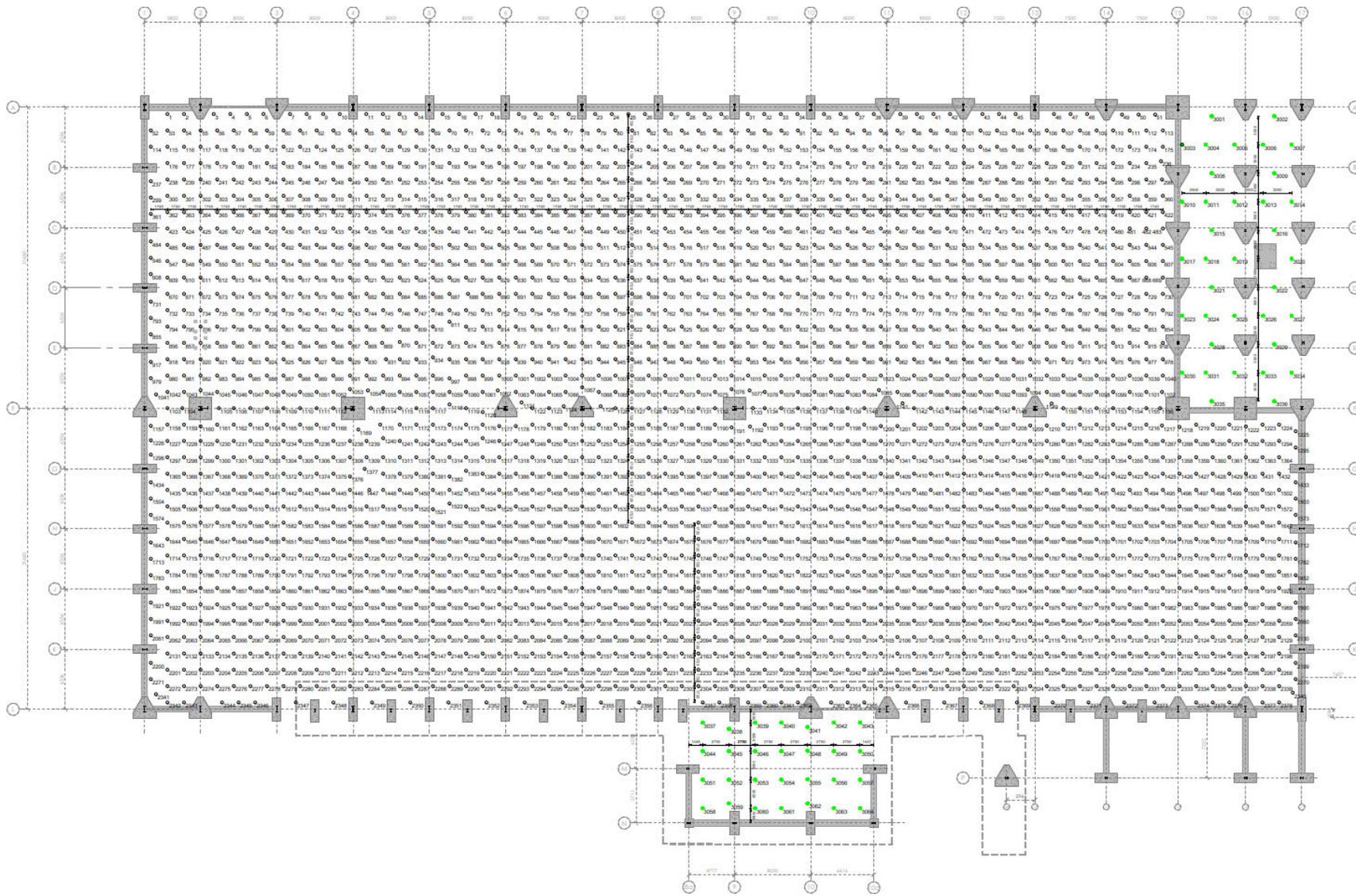
Cross-Section - LTP with RI

CONTINUOUS HELICAL DISPLACEMENT PILES (CHD)

Auger displacement steel reinforced concrete pile in a helical formation with a solid central core.

- Direct distribution of structural loading through the shaft and flights via skin friction resistance and end bearing into competent underlying soils.
- As part of the design process a balance of negative, positive skin friction resistances and end bearing (Neutral plane).
- Steel reinforcement cages and / or bars to provide structural support and lateral resistance and enhanced stiffness.





Frame:
 197 No. CHD (300/600)
 60 No. CHD (400/700)

Ambient / Cold Store:
 2378 No. RIs

Offices:
 65 No. RIs

Construction Layout

RI & CHD

INSTALLATION PROCESS

STEP 1

Drilling the bore – A multi-flight bullet-ended shaft is driven into the ground using a torque rotary head.

STEP 2

Pumping concrete – Concrete is pumped down the hollow shaft under pressure to the boring head as the tool is reverse-rotated and withdrawn, the helical shape with solid core.

STEP 3

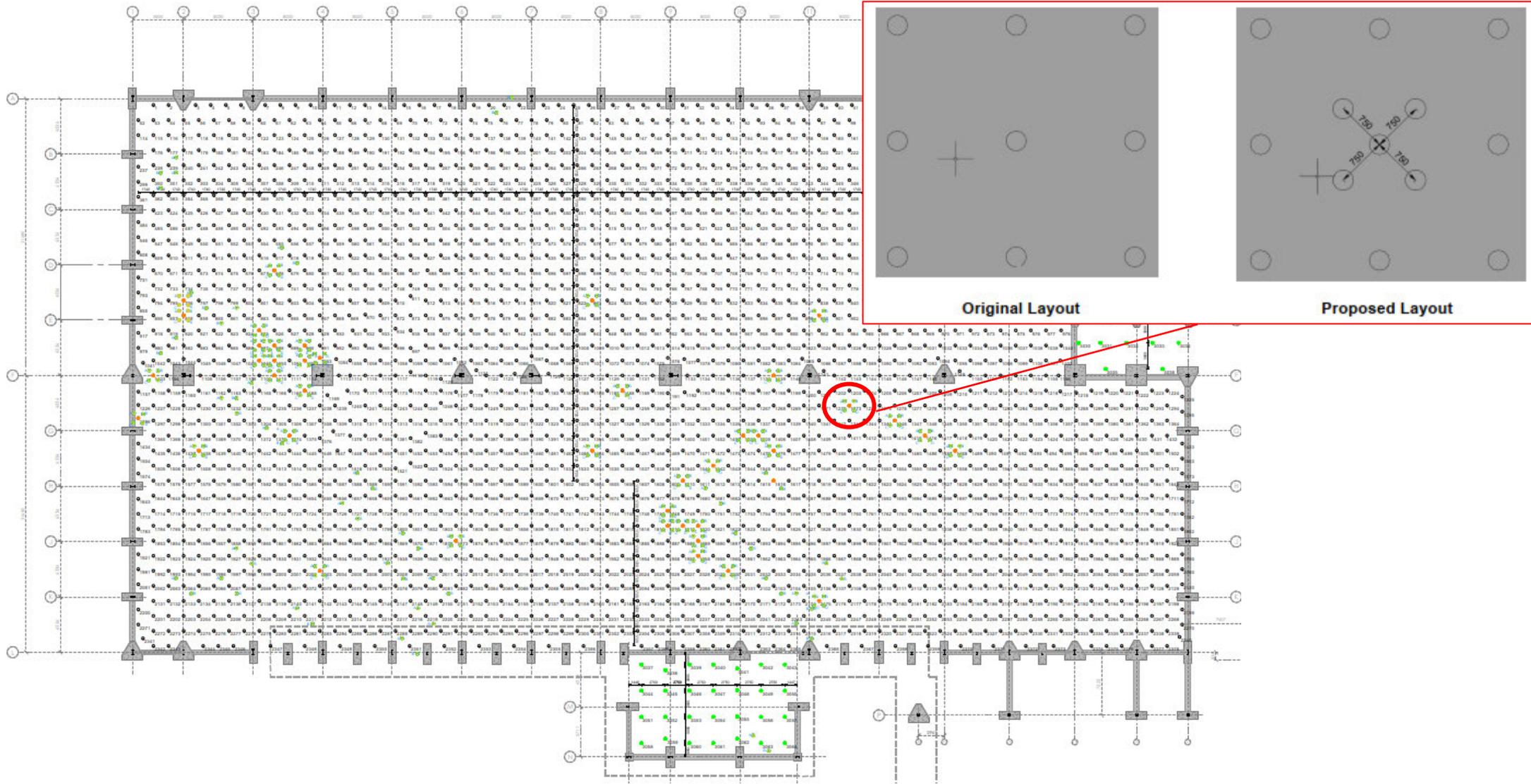
Excavation & LTP formation (RI) – Prior to curing, immediately following installation, RI heads are excavated as necessary, to allow formation of the load transfer platform (LTP).

Inserting reinforcement (CHD) – A reinforcement cage is inserted into the bore to ensure structural integrity. After curing period, cropping to require formation level.

STEP 4

Clearing heave and waste – Remove any excess material from formation to complete installation and ensures site levels are reinstated.





Original Layout

Proposed Layout

Replacements Layout

RI & CHD BENEFITS

COST-EFFICIENCY

Changing from CFA to CHD on the frame piles saved the client **£118,000.00** on equivalent pile number and depth.

Utilising RIs on the slab foundation saved against an equivalent capacity CHD solution by **£75,000**, excluding associated costs of cropping, disposal, tie beams and tie details within the foundations.

SUSTAINABILITY

Changing from CFA to CHD on the frame piles reduce the required concrete from **460 m³** on equivalent pile number and depth. Utilising RIs on the slab foundation reduced the required concrete volume on an equivalent pile capacity CHD solution by **150 m³**.

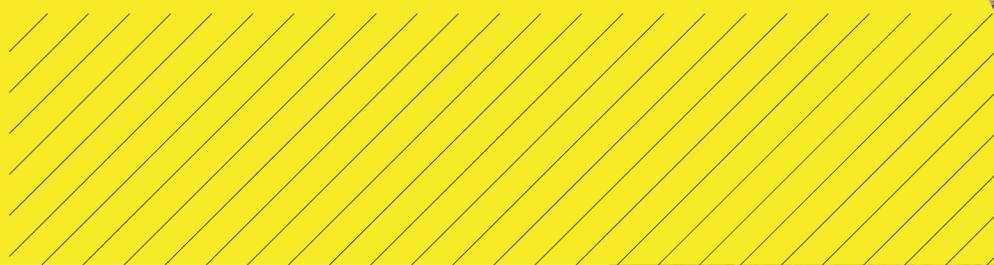
This change also reduced spoil generation by as much as **1,100m³** against equivalent CFA.

ENVIRONMENTAL

By changing from CFA to CHD on the frame, we reduced the foundations works projected equivalent CO₂ by **83 tonnes**, inclusive of concrete and waste disposal.



Case Study: Longbridge VSC, CFA & RBeam





West Works Site, Longbridge Vibro Stone Columns x CFA Piles and Foundation Package

Key issues/requirements

Deep made ground
Variable soils
Complex ground history
Significant enabling works

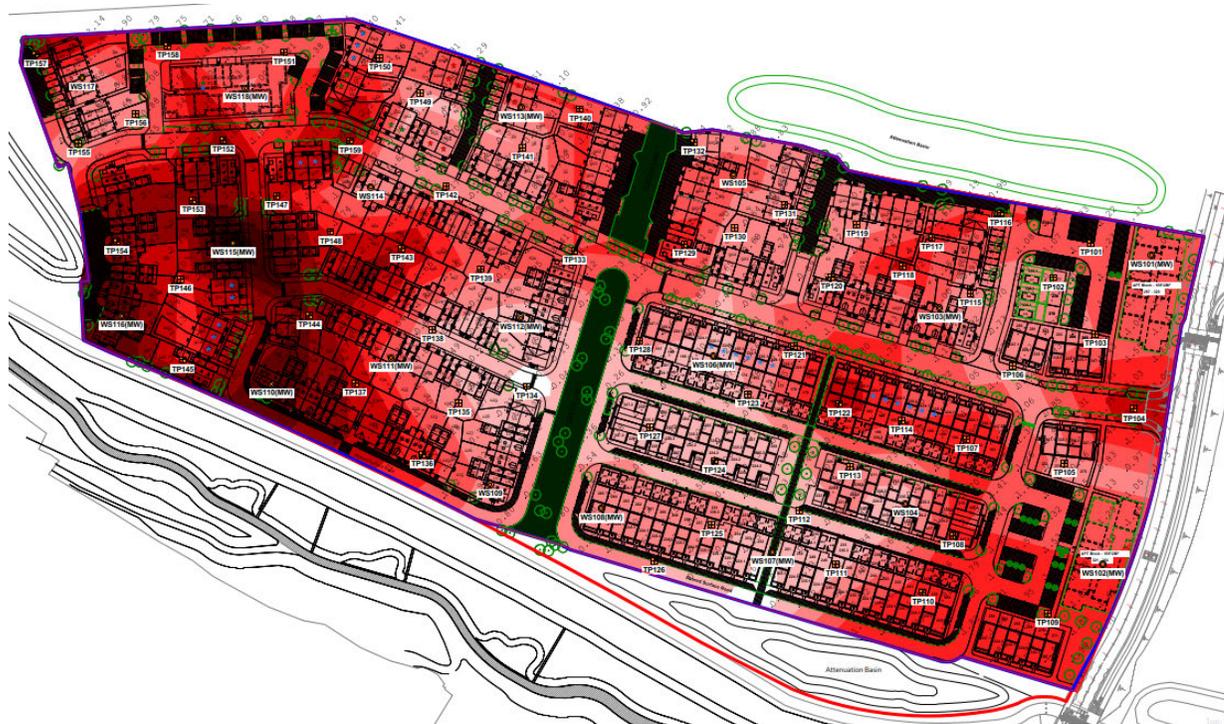
Project Solution

Multiple techniques delivered to provide the best value foundation solutions on a plot-by-plot basis



ROGER BULLIVANT





e3p		Borehole Log		Borehole No. WS105 Sheet 1 of 1		
Project Name: Longbridge West		Project No. 15358	Co-ords: 400468.00 - 277866.00		Hole Type WS	
Location:		Level:		Scale: 1:50		
Client: St Modwen Homes		Dates: 08/06/2022 -		Logged By J.Beer		
Well	Water Strikes	Samples and In Situ Testing		Depth (m)	Level (m)	Legend
		Depth (m)	Type			
		1.00		N=8 (3.3/2.2,2.2)	1.20	MADE GR: gravely c/s sub-angle sandstone,
		2.00	D			Firm low st slightly gra sub-angle (Becoming)
		2.00	ES	N=8 (2.2/2.2,2.2)		
		3.00	D	N=8 (1.2/2.2,2.2)		
		4.00	D	N=12 (2.2/3.3,3.3)	4.45	
Remarks 1. Terminated due to hole collapse at 4.00 m bgl. 2. Water strike at 2.00 m bgl.						

RLRE		Borehole Log		Borehole No. CP202 Sheet 1 of 1						
Project Name: (RS108) Longbridge West Structures		Project No. P22-383	Co-ords: 400300E - 277794N		Hole Type CP					
Location: Longbridge, Birmingham		Level: 176.76		Scale: 1:50						
Client: St Modwen Homes		Dates: 13/04/2023		Logged By BD						
Depth (m)	Ref	Sample and In Situ Testing		Level (m)	Depth (m)	Stratum Description	Legend	Water Strikes	Well	
		Type	Results							
1.00		SPT	N=16 (3.3/4.3,4.5)		1	MADE GROUND: Reddish brown slightly sandy gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded brick, concrete, timber, clinker, rebar, wire and metal.				
2.00		SPT	N=16 (2.4/4.4,3)		2					
3.00		SPT	N=14 (2.5/2.3,4.5)		3					
4.00		SPT	N=11 (2.2/2.3,3.3)		4					
5.00		SPT	N=20 (4.3/4.4,6.6)		5					
6.00		SPT	N=34 (6.7/10.8,6.8)		6					
7.00		SPT	N=30 (4.5/6.7,7.10)	170.06	7		MADE GROUND: Grey becoming reddish brown mottled grey extremely weak MUDSTONE/SILTSTONE. (Reworked (Narrow))			
8.00		SPT	N=24 (4.5/6.5,5.8)	169.76	8		Extremely weak dark reddish brown MUDSTONE. (Ainsley Member - Mudstone)			
End of Borehole at 8.00m.										
Remarks 1. Borehole terminated at 8.0m. 2. No groundwater encountered. 3. No visual or olfactory contamination observed. 4. Borehole backfilled with arisings upon completion.										

1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00

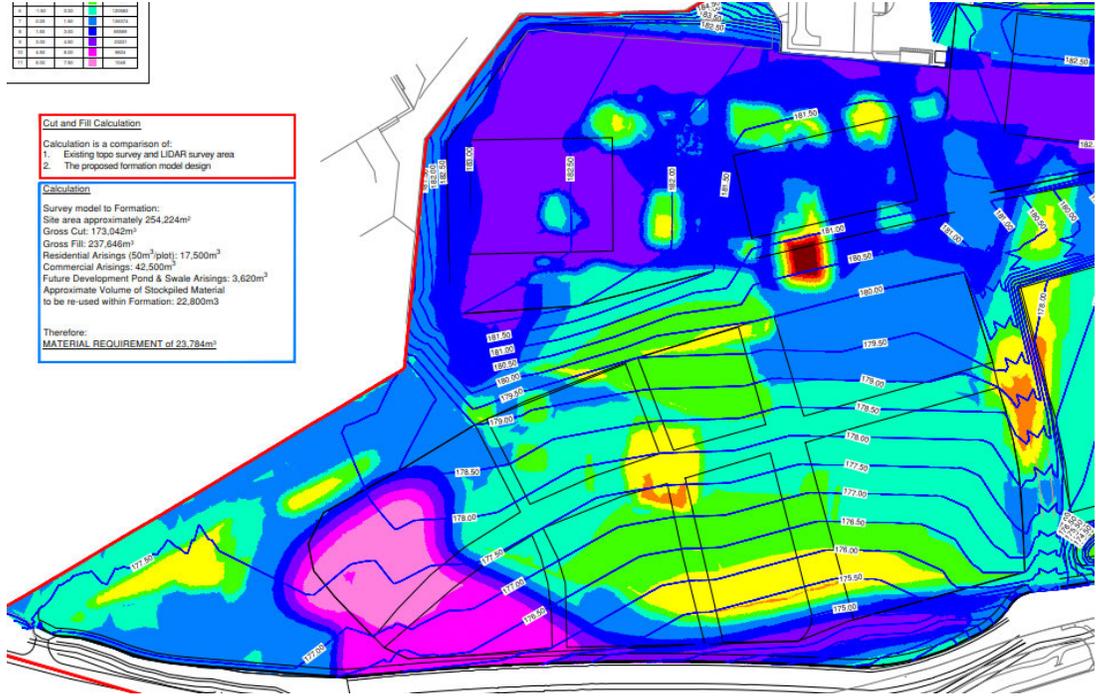
Cut and Fill Calculation

Calculation is a comparison of:
 1. Existing topo survey and LIDAR survey area
 2. The proposed formation model design

Calculation

Survey model to Formation:
 Site area approximately 254,224m²
 Gross Cut: 173,042m³
 Gross Fill: 237,646m³
 Residential Arisings (50m²/plot): 17,500m³
 Commercial Arisings: 42,500m³
 Future Development Pond & Swale Arisings: 3,620m³
 Approximate Volume of Stockpiled Material to be re-used within Formation: 22,800m³

Therefore:
MATERIAL REQUIREMENT of 23,784m³



VALUE ENGINEERING APPROACH

Initial Concept	RBL Proposal
<p>Mix of traditional strip footings and CFA piling with cast instu ground beams</p>	<p>Vibro Stone Columns</p> <ul style="list-style-type: none">• 3812 stone columns ranging from 3.5m to 8m• 150kN/m² bearing capacity with settlement limited to 25mm• Pre-bore utilised in some areas to accommodate full depth treatment <p>CFA</p> <ul style="list-style-type: none">• 2935lm 300mm dia CFA installed to depths between 14m – 20m• 425kN compression with a FOS of 3.0• Mix of precast and cast instu caps. <p>Beams</p> <ul style="list-style-type: none">• 739m of RBeam

WHAT ARE VIBRO STONE COLUMNS?

Vertical inclusions of dense, compacted gravel or stone installed using a vibrating tool.

- Reduce Settlement
- Improve Bearing Capacity
- Increase shear strength
- Reduce risk of Liquefaction
- Allows the use of shallow foundations



VIBRO STONE COLUMNS

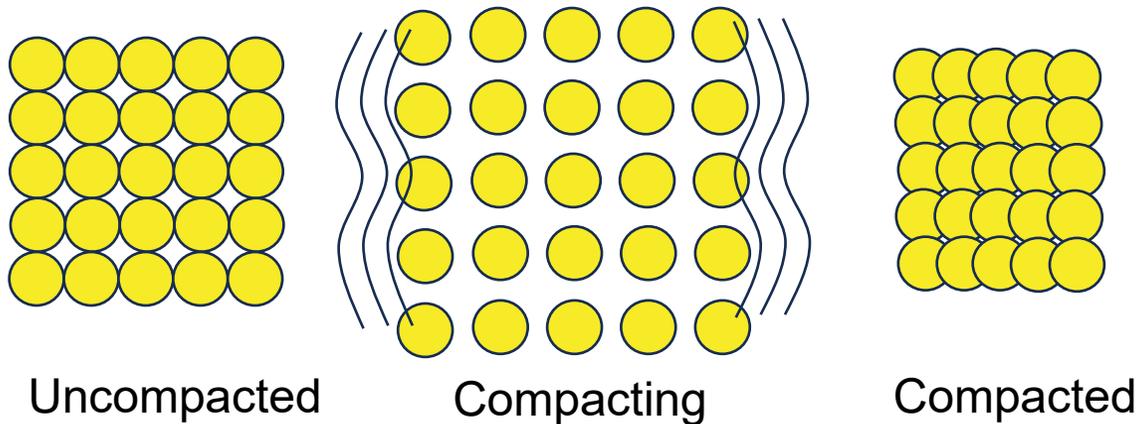
REPLACEMENT OR COMPACTION (OR BOTH)

Vibro Compaction

Granular Soils (Sands, Gravels)

Densifies existing soil using vibration

Additional material not always required

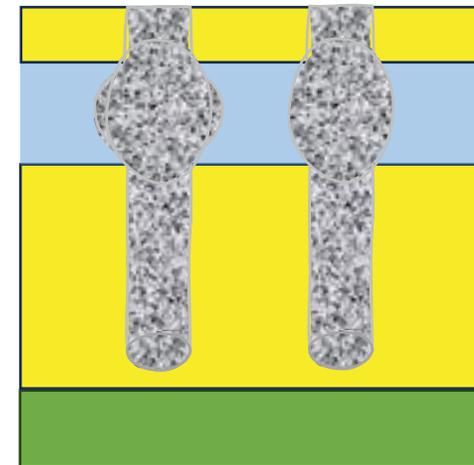


Vibro Replacement

Cohesive or mixed soils (soft clays, silts, fills)

Reinforces soil with compacted stone column

Single size aggregate, recycled aggregate



VIBRO STONE COLUMNS

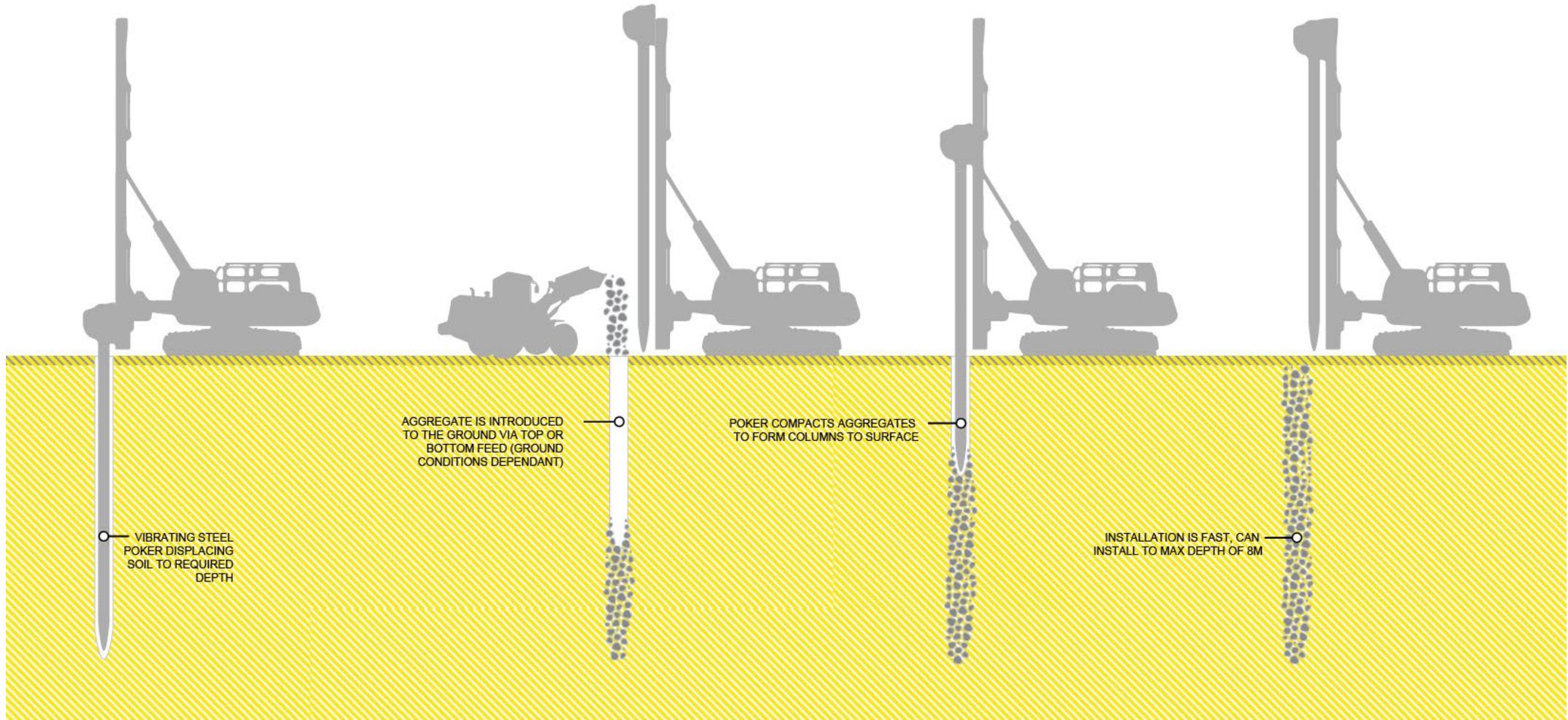
SUITABLE SOILS

Product	Soil type						
	 Peat 5 4 3 2 1 metres	 Silt 2 4 8 N value	 Clay 20 50 80 cu	 Sand loose – med density	 Gravel loose – med density	 Inert made ground	 Domestic refuse 10% 20% 50% of volume
vibro stone columns							
vibro compaction							
dynamic compaction							
dry soil mixing							
compaction grouting							

- ✓ Granular Soils
- ✓ Cohesive Soils
- ✓ Made Ground
- ✓ Obstructions
- ✓ Organic Matter

VIBRO STONE COLUMNS

THE INSTALLATION PROCESS



VIBRO STONE COLUMNS VALIDATION / TESTING

1. Plate Tests



2. Dummy Footing Tests.

3. Zone Test



VIBRO STONE COLUMNS

BENEFITS



Designed in-house



Recycled Aggregates



Zero spoil



Cost-effective solution



Immediate follow-on construction



Quick installation



RBEAM

PRECAST GROUND BEAM SYSTEM



RBEAM

PRECAST GROUND BEAM SYSTEM

1.



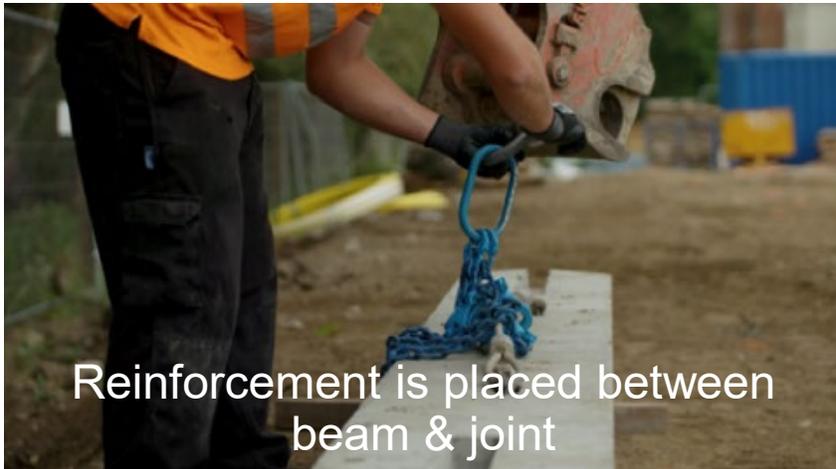
Precast Caps are placed onto pile using bedding mix

2.



Beams are laid onto the caps

3.



Reinforcement is placed between beam & joint

4.



Insitu concrete is poured to secure joints & tie whole system together

RBEAM

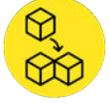
BENEFITS



Package solution - design, setting out, manufacture & installation.



Factory quality & safety.



Produces a flexible modular foundation.



Improved cost certainty.



Reduced waste.



Manufactured using low carbon concrete.



Ideal for both traditional and modern methods of construction.



Summary



VALUE ENGINEERING

WHAT ARE THE BENEFITS?



Cost reduction

Identifies unnecessary expense without compromising on quality.



Improved project value

Prioritises project objectives to deliver maximum value for money.



Enhanced quality & performance

Encourages innovative alternatives that improve durability, efficiency and functionality.



Optimised use of materials & resources

Cuts waste by selecting more efficient materials, methods and systems.



Environmental & sustainability benefits

Reduces carbon footprint through better resource management.

VALUE ENGINEERING

WHAT ARE THE BENEFITS?



Cost reduction

Identifies unnecessary expense without compromising on quality.



Improved project value

Prioritises project objectives to deliver maximum value for money.



Enhanced quality & performance

Encourages innovative alternatives that improve durability, efficiency and functionality.



Optimised use of materials & resources

Cuts waste by selecting more efficient materials, methods and systems.



Environmental & sustainability benefits

Reduces carbon footprint through better resource management.

VALUE ENGINEERING

WHAT ARE THE BENEFITS?



Cost reduction

Identifies unnecessary expense without compromising on quality.



Improved project value

Prioritises project objectives to deliver maximum value for money.



Enhanced quality & performance

Encourages innovative alternatives that improve durability, efficiency and functionality.



Optimised use of materials & resources

Cuts waste by selecting more efficient materials, methods and systems.



Environmental & sustainability benefits

Reduces carbon footprint through better resource management.

VALUE ENGINEERING

WHAT ARE THE BENEFITS?



Cost reduction

Identifies unnecessary expense without compromising on quality.



Improved project value

Prioritises project objectives to deliver maximum value for money.



Enhanced quality & performance

Encourages innovative alternatives that improve durability, efficiency and functionality.



Optimised use of materials & resources

Cuts waste by selecting more efficient materials, methods and systems.



Environmental & sustainability benefits

Reduces carbon footprint through better resource management.

VALUE ENGINEERING

WHAT ARE THE BENEFITS?



Cost reduction

Identifies unnecessary expense without compromising on quality.



Improved project value

Prioritises project objectives to deliver maximum value for money.



Enhanced quality & performance

Encourages innovative alternatives that improve durability, efficiency and functionality.



Optimised use of materials & resources

Cuts waste by selecting more efficient materials, methods and systems.



Environmental & sustainability benefits

Reduces carbon footprint through better resource management.

Q & A



Thank you for listening



ROGER BULLIVANT

✉ info@roger-bullivant.co.uk

in [@rogerbullivantlimited](https://www.linkedin.com/company/rogerbullivantlimited)