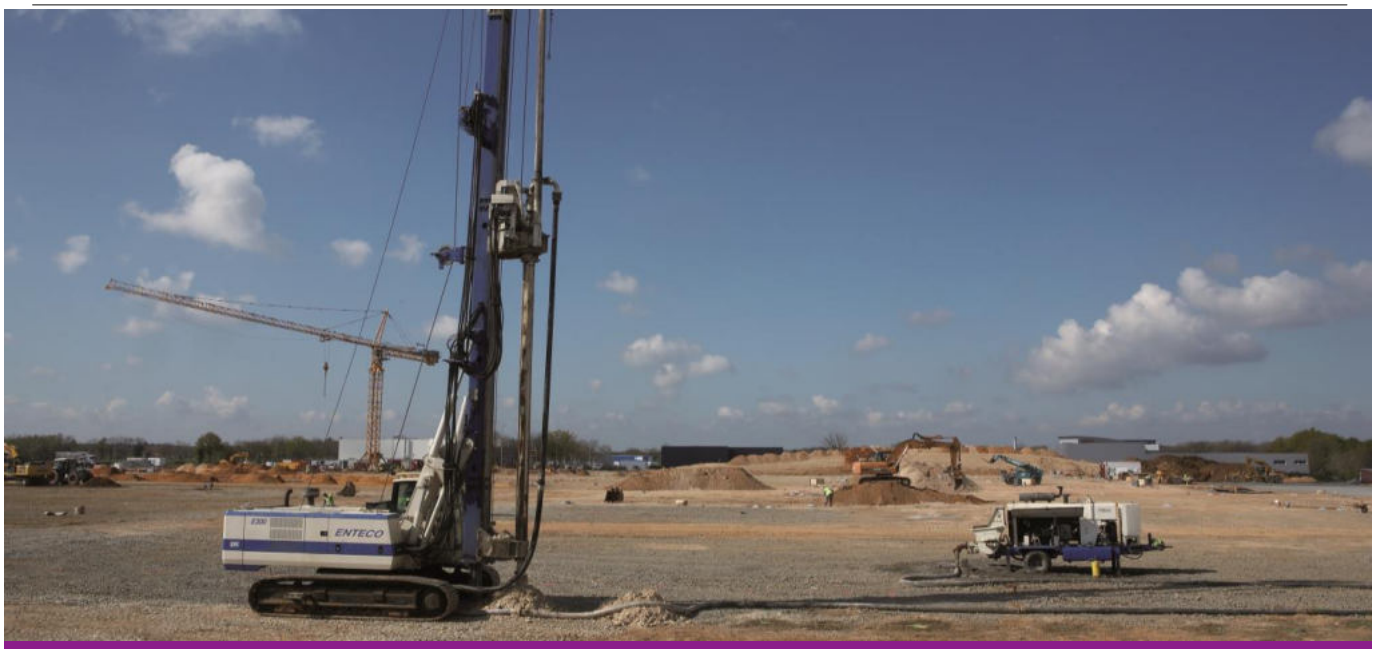
TECHNIQUE SHEET

Balfour Beatty Ground Engineering




# PENCOL™ RIGID INCLUSIONS

**PENCOL™ offers a highly economical and sustainable alternative to piling. It is an effective ground improvement technique developed to provide enhanced bearing capacity and settlement control in very weak or organic soils.**

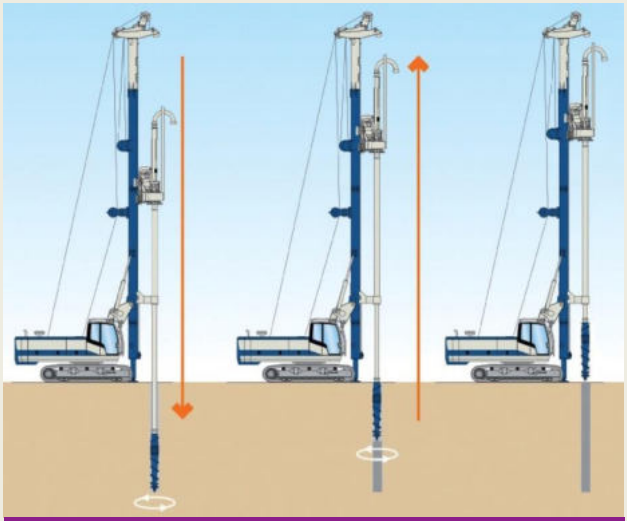
## BASIC TECHNIQUE

The PENCOL™ system is installed using either a rotary displacement hollow auger or a vibrated driven steel tube which can tighten the surrounding soil. At the bottom of the tool, a lost or recoverable shoe prevents any ingress of materials during penetration.

Once the required design depth and/or torque are achieved the high slump mortar (or concrete) is pumped continuously using a bottom feed method at positive pressure through the hollow stem or tube during extraction so forming the Rigid Inclusion.

The combined effect of densification and reinforcement improve the engineering performance of the soft ground resulting in a composite mass with enhanced settlement and load bearing characteristics.

## EXPLAINING THE PROCESS



INSTALLATION SEQUENCE

Stage 1 – A displacement auger penetrates to design depth

Stage 2 – The auger is extracted and grout/concrete is pumped under controlled pressure

Stage 3 – Completed Pencol Inclusions are formed

# TECHNIQUE SHEET

Balfour Beatty Ground Engineering

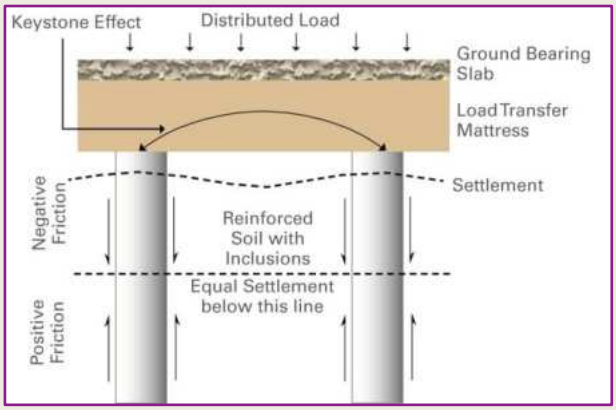
INSTALLATION OF PENCOL COLUMNS

PENCOL INSTALLATION - AUGER DISPLACEMENT TECHNIQUE

## THE BENEFITS

- ✓ Can be used in almost ALL ground conditions.
- ✓ Very economical and fast construction - up to 2,500m/week.
- ✓ Ground Improvement used with granular mattress allowing ground bearing slabs and conventional foundations (strip/pad/raft) to be used.
- ✓ Suitable in very soft clay and peat where Vibro Stone Columns cannot be used.
- ✓ Displacement system - limited or no spoil produced (ideal for brownfield/contaminated sites).
- ✓ Excellent settlement control, even for heavy loading conditions (up to 250kN/m²).
- ✓ Embankments can be built quickly, without delay or the need for staged construction.
- ✓ Global stability of embankment is improved.

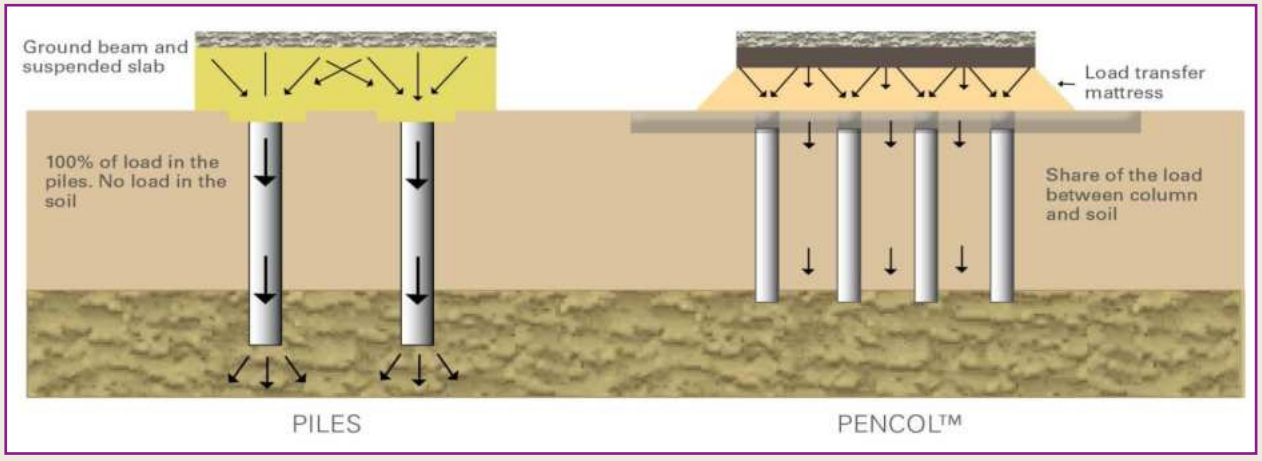
## DESIGN




The PENCOL™ system is a form of ground improvement whereby closely spaced grouted columns or rigid inclusions (0.3 - 0.6m diameter) are designed and installed to reinforce the soil to provide a stiffened, composite soil mass. Unlike piling, the soil between the PENCOL™ Inclusions carries a proportion of the load.

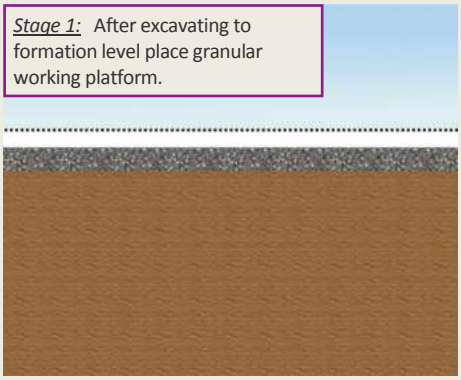
The system requires a nominal granular load transfer mattress (at least 0.5m thick) to help transfer the load and provide uniform conditions.

## THE PRINCIPAL DIFFERENCE BETWEEN PILES & PENCOL

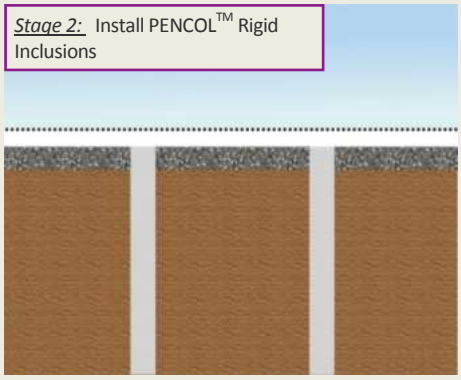


## DETAILED INSTALLATION SEQUENCE

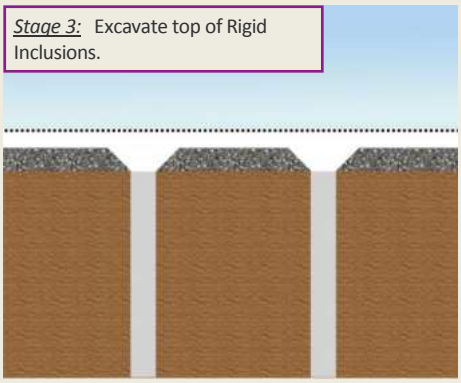
*Stage 1:* After excavating to formation level place granular working platform.



*Stage 2:* Install PENCOL™ Rigid Inclusions

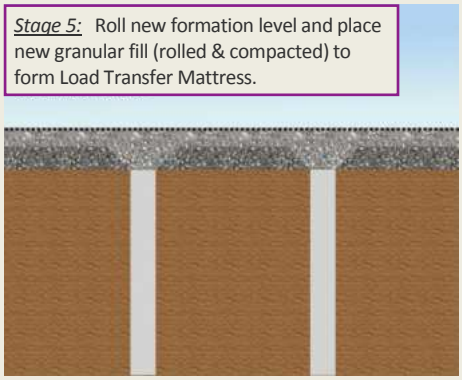


*Stage 3:* Excavate top of Rigid Inclusions.

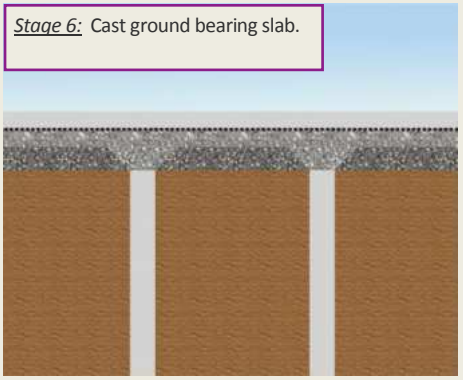


*Stage 4:* Backfill excavations.

*Stage 5:* Roll new formation level and place new granular fill (rolled & compacted) to form Load Transfer Mattress.



*Stage 6:* Cast ground bearing slab.



## SUITABILITY OF PENCOL RIGID INCLUSIONS

| METHOD | SOIL TYPE: PEAT | SILT | CLAY | SAND | GRAVEL | INERT MADE GROUND | DOMESTIC REFUSE |
|---|---|---|---|---|---|---|---|
| Band Drains | | | | | | | |
| Vibro Compaction | | | | | | | |
| Vibro Stone Columns | | | | | | | |
| Dry Soil Mixing | | | | | | possible application | |
| Dynamic Compaction | | possible application | possible application | | | | possible application |
| PENCOL™ | | | | | | | |

*Note: This table is indicative only, some exceptions apply*

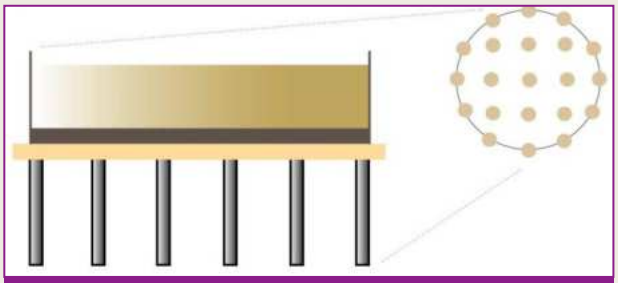
# TECHNIQUE SHEET

Balfour Beatty Ground Engineering

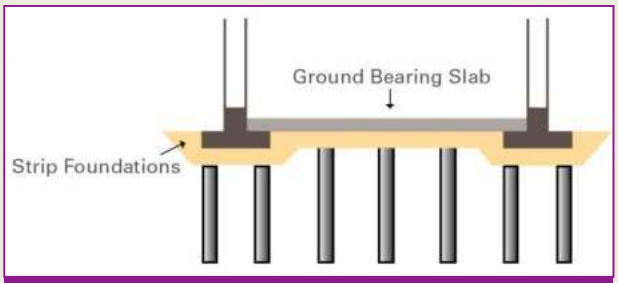
SOME HEAVE DURING INSTALLATION PROCESS

MULTIPLE RIGS WORKING ON SITE

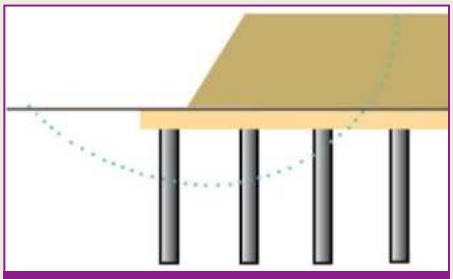
## APPLICATIONS



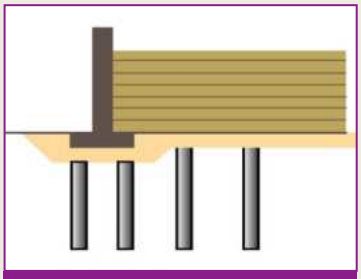
TANKS



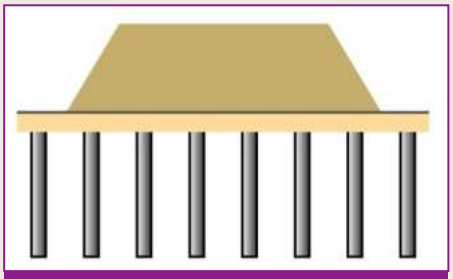

HOUSING / COMMERCIAL / RETAIL / INDUSTRIAL UNITS



SLOPES



RETAINING WALLS



ROAD / RAILWAY EMBANKMENTS

## TECHNICAL CAPABILITIES – PENCOL RIGID INCLUSIONS

| Specification | From | To |
|---|---|---|
| Practical Depth | 2.5m | 25m |
| Diameter | 0.3m | 0.6m |
| Typical Load Capacity | 10kN/$m^2$ | 250kN/$m^2$ (subject to soil conditions) |

## CONTACT US

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