



## 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.

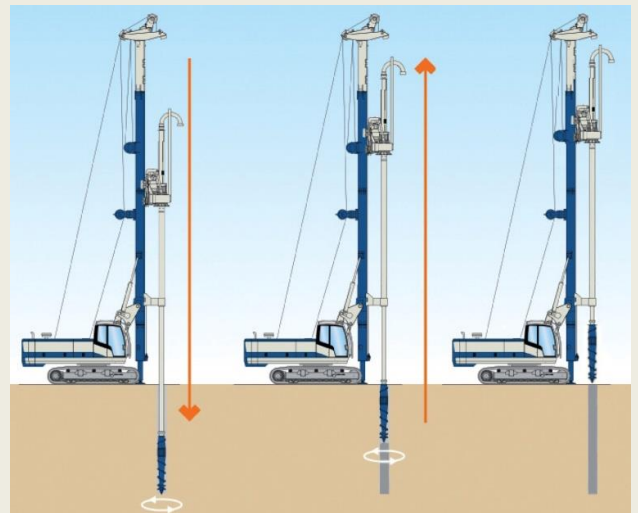
### BASIC TECHNIQUE

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 Pencil Inclusions are formed



INSTALLATION OF PENCOL COLUMNS

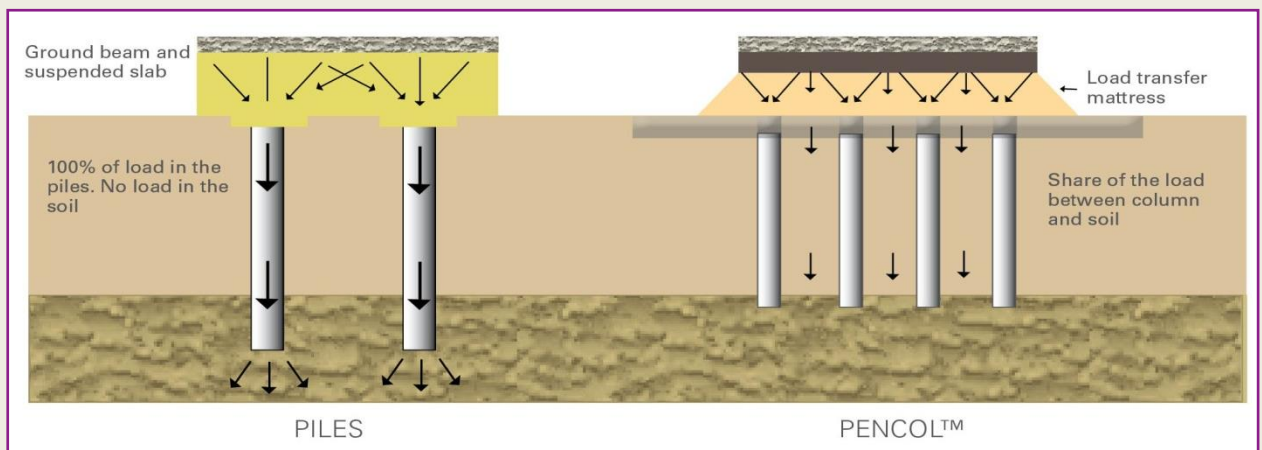


PENCOL INSTALLATION - AUGER DISPLACEMENT TECHNIQUE

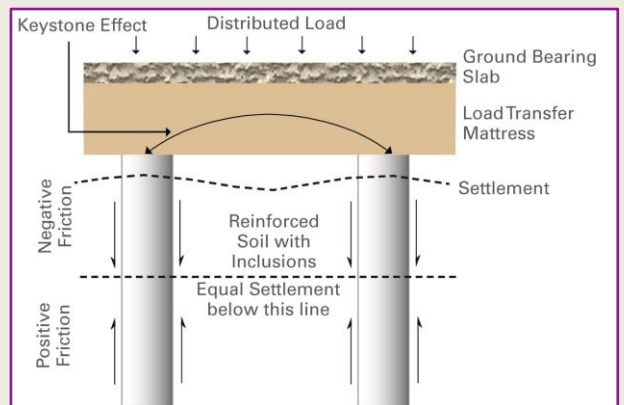
### THE BENEFITS

- ✓ 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/m<sup>2</sup>).
- ✓ Embankments can be built quickly, without delay or the need for staged construction.
- ✓ Global stability of embankment is improved.

### ◆ THE PRINCIPAL DIFFERENCE BETWEEN PILES & PENCOL



### DESIGN

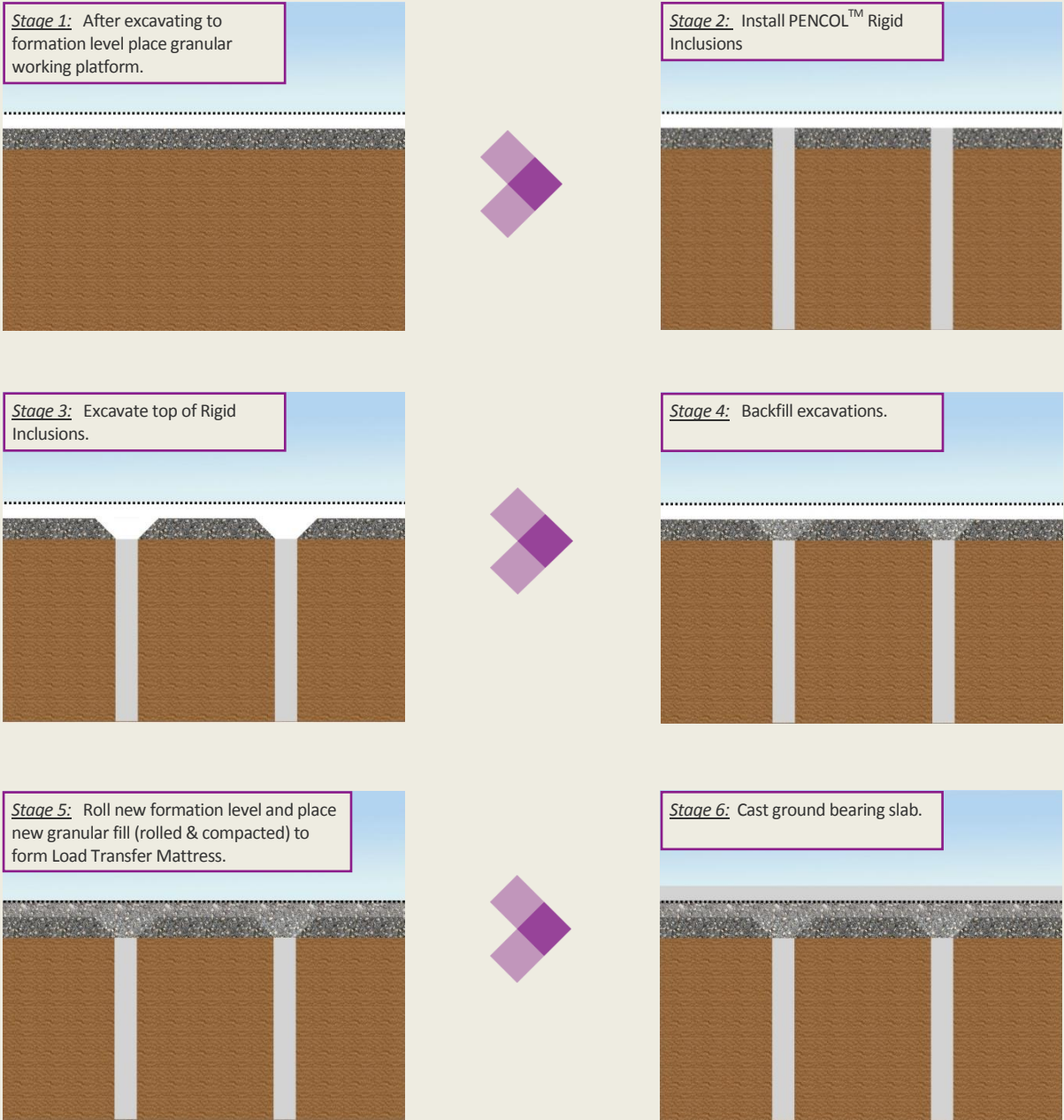


The PENCOL™ system is a form of ground improvement whereby closely spaced grouted columns or rigid inclusions (0.3 - 0.6m diameter) are designed and installed to reinforce the soil to provide a stiffened, composite soil mass. Unlike piling, the soil between the PENCOL™ Inclusions carries a proportion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



## DETAILED INSTALLATION SEQUENCE



## SUITABILITY OF PENCOL RIGID INCLUSIONS

METHOD	SOIL TYPE						
	PEAT	SILT	CLAY	SAND	GRAVEL	INERT MADE GROUND	DOMESTIC REFUSE
Band Drains	X	■	■	X	X	X	X
Vibro Compaction	X	X	X	■	■	X	X
Vibro Stone Columns	X	■	■	■	■	■	X
Dry Soil Mixing	■	■	■	X	X	possible application	X
Dynamic Compaction	X	possible application	possible application	■	■	■	possible application
<b>PENCOL™</b>	■	■	■	■	■	■	■

Note: This table is indicative only, some exceptions apply

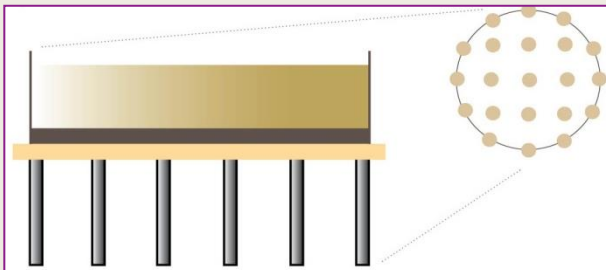


SOME HEAVE DURING INSTALLATION PROCESS

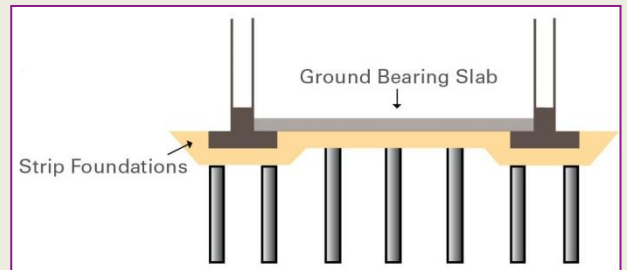


MULTIPLE RIGS WORKING ON SITE

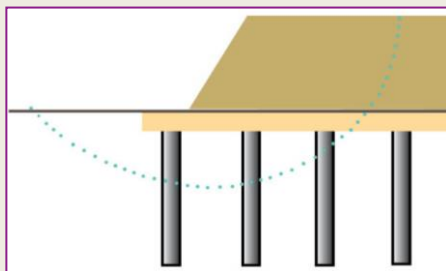
## APPLICATIONS



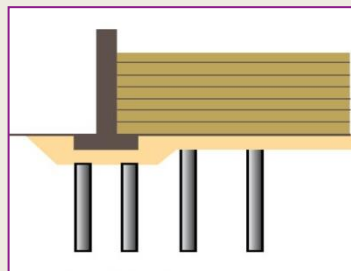
TANKS



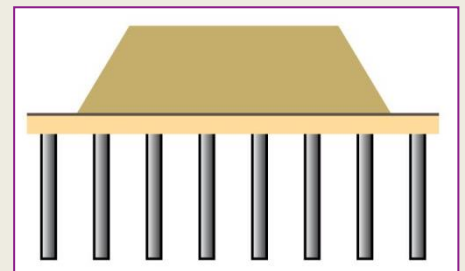
HOUSING / COMMERCIAL / RETAIL / INDUSTRIAL UNITS



SLOPES



RETAINING WALLS



ROAD / RAILWAY EMBANKMENTS



## TECHNICAL CAPABILITIES – PENCIL RIGID INCLUSIONS

Specification	From	To
Practical Depth	2.5m	25m
Diameter	0.3m	0.6m
Typical Load Capacity	10kN/m <sup>2</sup>	250kN/m <sup>2</sup> (subject to soil conditions)

## CONTACT US

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