Engineering

BIO-INSPIRED RADIALLY EXPANSIVE PILE (BREP) AND BIO-INSPIRED SETAE ANCHORED PILE (BSAP)

CLAIM:

Bio-inspired radially expansive pile (BREP) and bio-inspired setae anchored pile (BSAP) are two innovative deep foundation systems with efficiently improved load carrying capacities compared to conventional bored and driven piles.

NOVELTIES:

BREP novelties:

• Use of a two-part shell (longitudinally split steel pipe that makes the outer shell of the system, like the shell of a razor clam) that allows lateral expansion.
• Use of a flexible, nearly incompressible, inner core that has a high Poisson's ratio, like the hydrostatic skeleton of an earthworm that converts vertical load to hydrostatic pressure. Vertical compression of the inner core causes lateral expansion that increases the normal confining pressure on the pile shell.

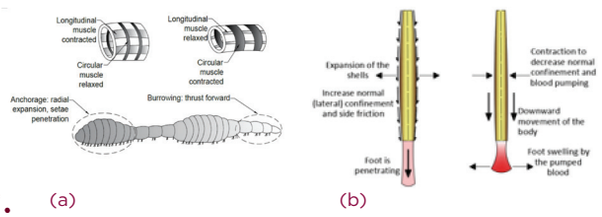
BSAP novelties:

• Use of a two-arc shell that allows lateral expansion, like the shells of a razor clam.
• Use of a mechanical expansion devices (scissor-type jacks) welded inside the two-arc shell to increase normal confining pressure from the surrounding soil.
• Use of bristles (setae structures) welded outside the shells inserted by the jacking forces into the surrounding soil as extra anchorage to improve pile capacity, like setae anchorage mechanism of earthworms that are inserted into the surrounding soil by protractor muscles.

FEATURES:

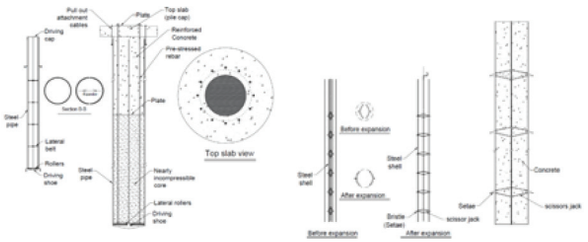
The following items listed below are included in both BSAP and BREP:

- Greater load carrying capacity than conventional deep foundations with the same dimensions, or providing the same load carrying capacity with smaller dimensions compared to conventional deep foundations.
- Using less material than current bored and driven piles.
- Using less fuel/energy for material transportation and installation because it is a much shorter pile (compared to bored and precast concrete piles designed for the same load carrying capacity).
- The designs present a straightforward concept and technology that is expected to be implemented after proof-of-concept testing.
- Reduced carbon emissions (from reduced portland cement usage and reduced pile driving energy).
- BREP and BSAP mechanisms should also improve anchorage capacity against uplift.



(a) (b)

Figure 1. Anchorage behavior of the bio-analogs: (a) earthworm muscle expansion and contraction and extension of bristles into the soil for anchorage, (b) razor clam bi-valve shell expansion and contraction for anchorage



(a) (b)

Figure 2. Bio-inspired design: (a) Bio-inspired Radially Expansive Pile (BREP), (2) Bio-inspired Setae Anchored Pile (BSAP)

POTENTIAL APPLICATIONS:

- Deep foundations
- Anchorage systems

POTENTIAL MARKETS:

Civil engineering and geotechnical engineering design firms and construction companies, particularly those that work on deep or pile foundations.

INVENTOR(S) EXPERTISE

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