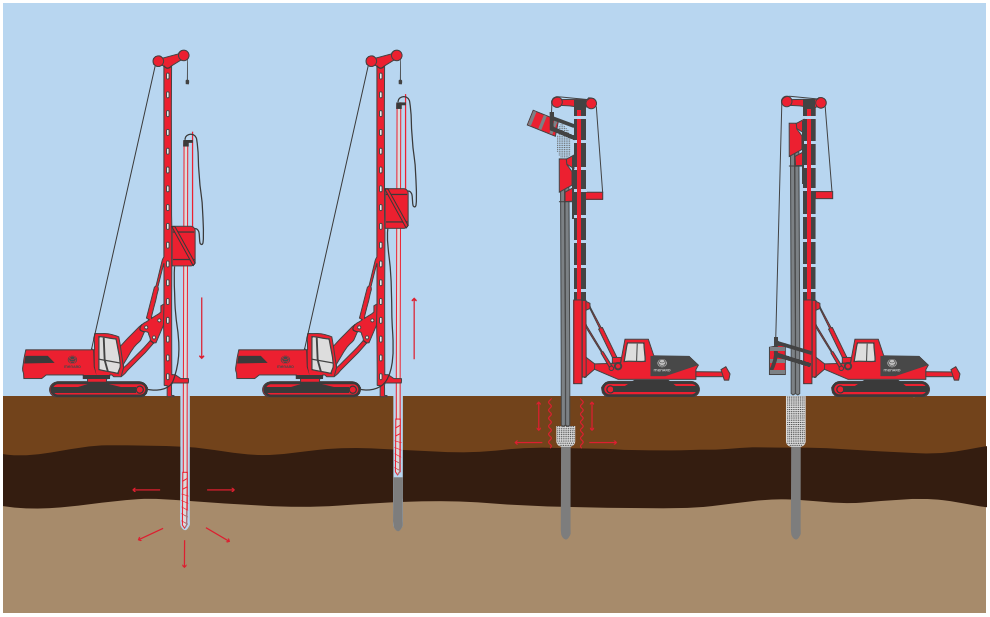
Bi-Modulus Columns (BMCs)®



CMC installed with displacement drilling methods (left). Stone column installed on top of CMC with stone column equipment (right).

Advantages of BMCs include:

- Combines the benefits of CMCs and stone columns
- Ideal for layered sites with granular soils over compressible layers
- Reduces thickness or eliminates the need for LTP
- Mitigates liquefiable layers
- Simplifies challenges associated with excavating the tops of elements to accommodate the bottom of footing elevations

Bi-Modulus Columns (BMC)® are vertical ground improvement elements that are consist of a Controlled Modulus Column (CMC)® that is topped with a compacted granular column. By combining CMCs and stone columns, BMCs are designed to offer the distinct advantages of both types of vertical elements.

Installation

BMCs are constructed by installing CMCs from the bottom tip of the element to the desired top of CMC elevation, allowing the grout of the freshly installed CMC to partially set up, and following on with the stone column installation from the top of CMC elevation to the ground surface.

The stone column is installed on top of the freshly grouted CMC, and stone is driven into the upper portion of the CMC to form an approximately 3-ft transition zone. CMC diameters range from approximately 12 to 18 inches, and the stone columns typically range from 18 to 42 inches in diameter.

Applications

CMCs offer numerous advantages including, the ability to span very soft soils, support very high bearing pressures, and are economical for very deep installations. The benefits of stone columns include easy excavation of elements below foundations, no requirement of load transfer platforms (LTPs), and densification of surrounding soils.

BMCs can be used when there are granular soils on top of compressible soils too soft for stone columns (e.g., when the compressible layer does not offer adequate confinement for the stone columns to function properly). They are also used when there are liquefiable soils above compressible soils – with the stone columns densifying or reinforcing the granular soils to mitigate the risk of liquefaction, and the CMCs reinforcing the compressible layers. At sites where LTP material is not readily available or is very costly, BMCs can be used to reduce the thickness or eliminate the need for an LTP.