Solutions matrix
The solution to any geotechnical challenge

- Deep foundations
- Earth retention/shoring
- Environmental containment
- Foundation rehabilitation
- Ground improvement
- Groundwater control
- Heave control
- Marine structure support
- Mine stabilization/void filling
- Railroad subgrade stabilization
- Seismic/liquefaction mitigation
- Sinkhole/karst remediation
- Slope stabilization
- Tunneling stabilization
- Underpinning

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Earthquake drain programs are designed to limit liquefaction. Earthquake drains are high flow capacity, prefab systems used to treat a range of loose or porous soil types. Jet grouting is a densification technique that engages the surrounding soil, providing reinforcement and increased bearing capacity. Micro piles are small-diameter, low- to high-capacity structural elements that can provide compressive, tensile, or shear support as foundation or slope stabilization components. Micropiles can be installed in almost any type of ground, and in restricted access or low groundwater situations.

Jet grouting erodes the soil with high-velocity fluids and mixes the eroded soil with grout to create in situ cemented geometries of soilcrete and mixes the eroded soil with grout to create in situ cemented geometries of soilcrete. Vibro compaction is the densification of clean, cohesionless soils above and below the water table using a depth vibrator that vibrates in the horizontal direction. Vibro concrete columns are concrete inclusions constructed with a depth vibrator and attached tremie pipe to reinforce soil and densely adjacent granular soils when present.

Jet grouting is the injection of polyurethane grouts into concrete joints or cracks for permanent seepage control. HB PolyLift ® is a wet soil mixing technique that uses a full-depth cutter post to mix in situ soil with cement-based slurry. The result is a mixed-in-place wall constructed through compressible soils to reduce groundwater inflow. Sheet pile walls are installed by inserting interlocking steel sheets to provide temporary or permanent earth retention systems. Anchors can be incorporated to increase lateral support.

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### ADDITIONAL TECHNIQUES

- Cement grouting
- Chemical grouting
- Compaction grouting
- Fracture grouting / compensation grouting
- Injection systems
- Jet grouting
- Polyurethane grouting
- Cutter soil mixing
- Dry soil mixing
- Dynamic compaction
- Earthquake drains
- Rapid impact compaction
- Rigid inclusions
- TRD – soil mix walls
- Vibro compaction
- Vibro concrete columns
- Vibro Piers®
- Vibro replacement
- Wet soil mixing
- Wick drains
- Anchors
- Anchor block
- Anchor block for slope stabilization
- Gabions
- Micropile slide stabilization system (MS³)
- Sculpted shotcrete
- Secant or tangent piles
- Sheet piles
- Slurry wall – structural or cutoff
- Soil nailing
- Soldier piles & lagging
- CFA piles (auger cast)
- Displacement CFA piles
- Drilled shafts
- Driven piles
- Franki piles
- Helical piles
- Jacked piers
- Macropiles®
- Micropiles
- Dewatering
- Ground freezing
- Pit underpinning
- Post-tensioning
- Slab jacking

### CHALLENGES

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This chart represents techniques that could apply to the listed geotechnical challenges. The actual applicability of techniques listed active depend upon the soil or water conditions, site constraints, the specific requirements, and the cost and availability of equipment. Other considerations include accessibility, availability of materials, presence of obstructions in other design elements, and any other factors that could influence the feasibility. Consult with your Keller representative to discuss specific site conditions and appropriate Keller geotechnical construction solutions.

In combination with these techniques, we also provide automated instrumentation for monitoring the safety and stability of buildings, excavations, bridges, railways, roads, tunnels, dams, and embankments. Techniques include:

- **Instrumentation & Monitoring**
  - **Equipment**: level sensors, tiltmeters, inclinometers, pressure gauges, displacement transducers, strain gauges, temperature sensors, and meteorological sensors.
  - **Applications**: monitoring the safety and stability of structures during and after construction, monitoring the performance of geotechnical solutions, and monitoring the integrity of underground facilities.
  - **Benefits**: early detection of potential problems, real-time monitoring, and continuous monitoring during and after construction.

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