1.4.1.c Soil Replacement

Vibro-Replacement Stone Columns: Vibro-replacement stone columns, Fig. (1.25), improve the resistance of cohesionless soils to liquefaction by several mechanisms. The primary mechanism of treatment is the densification of the native soil. Secondary benefits may also come from the reinforcing effects of the stone columns (e.g.,. they are usually stiffer than the surrounding soil), an increase in the in-situ horizontal stress (e.g., due to the packing of stone in the column), and the drainage of earthquake-induced pore water pressures through the stone columns.

Vibro-displacement method uses compressed air to displace the soil laterally as a probe is advanced through the weak strata. Backfill is placed in to the hole in stages as the probe is incrementally withdrawn and lowered again to compact the fill. This process, also known as the 'dry method', forms a stone column. The columns are typically smaller in diameter than the 'wet' method and are used in the stiffer soils.

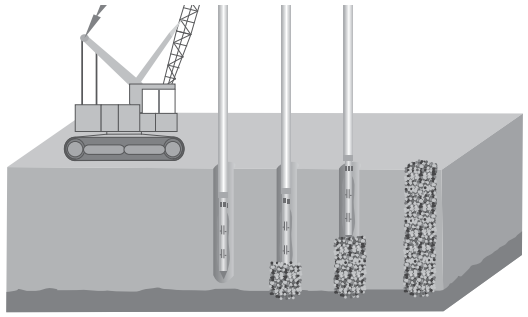

Fig. (1.25): Vibro-replacement Stone Columns Technique

1.4.1.d Soil Mixing

Soil Mixing, also known as the Deep Mixing Method, Fig.(1.26), is the mechanical blending of the in situ soil with cementitious materials (reagent binder) using a hollow stem auger and paddle arrangement. The intent of the soil mixing program is to achieve improved character, generally a design compressive strength or shear strength and/or permeability. Soil mixing can also be used to immobilize and/or fixate contaminants as well as a treatment system for chemical reduction to a more 'friendly' substrate

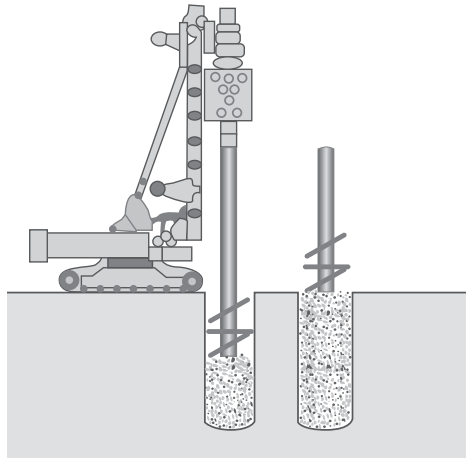

Fig. (1.26): Deep Mixing (Soil Mixing) Technique

Typically, the reagent is delivered in a slurry form (i.e. combined with water), although dry delivery is also possible. Depending on the soil to be mixed, the volume of slurry necessary ranges from 20 to 30 percent by volume. Can be a variety of materials including: Cement (Type I through V), Fly ash, Ground Blast Furnace Slag, Lime, Additives.

No single tool will be the best for all soil types and, for this reason, mix tools are often developed for individual projects. Considerations include: soil type and available turning equipment, often designed for particular site conditions, size ranges from 1.6 to 11.5-ft diameter, can be a combination of partial flighting, mix blades, injection ports and nozzles, and shear blades.

The in situ injection and mixing of cement into weak soils is becoming more common. Recent applications include liquefaction mitigation and the strengthening of weak cohesive soils adjacent to embankments, levees and bridge abutments.

1.4.1.e Grouting

Grouting can stiffen and strengthen the soil layer by increasing its density, increasing the lateral stresses, and acting as reinforcement. Grouting may also be used to produce controlled heaving of the ground surface to re-level a structure that has been damaged by differential settlements.