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A Review on Useful Ground Improvement Techniques

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***ABSTACT*— Ground improvement is the most imaginative field of geotechnical engineering. It is a field in which the engineer mould the ground to adopt the project requirements, by altering the natural state of the soil, instead of having to alter the design in response to the grounds natural limitations. The result usually include saving in construction cost and reduction of implementation time. There are number of techniques available for improving the mechanical and engineering properties of the soil. When the soil on a project site cannot support the loads, ground improvement to increase strength, reduce compressibility, and enhance performance under applied loadings may be required**.

I. INTRODUCTION

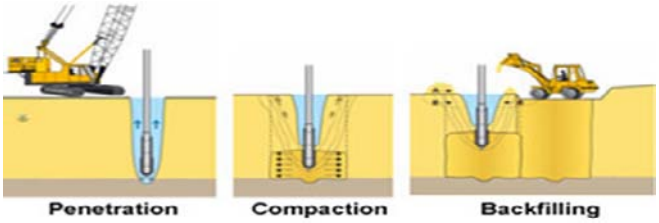
Transportation contributes to the industrial, economic, social and cultural development of nation transportation by road or highways is the only mode which could give maximum service to one and all. development of infrastructures in cities compelled the engineers to improve the properties of soil to bear the load transferred by the structures. as the land available may not be suitable for the structural load. the purpose of these techniques to increase bearing capacity of soil and reduce the settlement to a considerable extent. the process is used to make an area trafficable within short period of time for emergency & military purpose .in this paper various ground improvement techniques have been selected to increase the strength of soil.

II. TYPES OF GROUND IMPROVEMENT TECHNIQUE

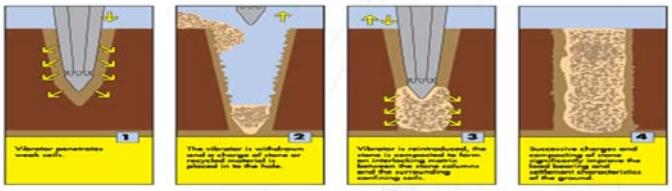
VERTICAL DRAINS: These consist of a column of pervious material placed in cylindrical vertical holes at sufficiently close spaces. All drains should be connected at the ground surface to a drainage blanket. Vertical drains accelerate consolidation by facilitating drainage of pore water. Vertical drains are laid out in rows, staggered, or aligned to form patterns of equilateral triangles or squares. Vertical drains are of two types: 1. SAND DRAIN 2.WICK DRAIN

1) SAND DRAIN: Sand drain is a simple process, employing a column of at least 10 inches in width augured into ground to be surcharged & consolidated. The column is then filled with sand and connected to a free-draining blanket of The column is then filled with sand and connected to a free-draining blanket of granular soil.
2) WICK DRAIN: wick drain is usually about, 4 inches wide, 1/8-inch thick which acts as a high-permeability conduit for water to flow out of the soil and to the surface. Most common application of wick drains is for accelerating the settlement rate of compressible soils.

VIBRO COMPACTION: It is a ground improvement process for densifying loose sands to create stable foundation soils. The action of the vibrator, usually accompanied by water jetting, reduces the inter-granular forces between the soil particles, allowing them to move into a denser configuration, typically achieving a relative density of 70% to 85%. Compaction is achieved above and below the water table.



STONE COLUMNS: Also known as vibro-replacement or vibro-displacement is a ground improvement process where vertical columns of compacted aggregate are formed through the soils to be improved. The vibrator first penetrates to the required depth by vibration and air or water jetting or by vibration alone. Gravel is then added at the tip of the vibrator and progressive raising and regeneration of the vibrator results in the gravel being pushed into the surrounding soil. The soil-column matrix results in an overall mass having a high shear strength and a low compressibility.



DYNAMIC COMPACTION: Dynamic Compaction is the dropping of heavy weights on the ground surfaces to density the soils at depth. It involves the repeated dropping of large steel tampers by means of crawler cranes. Tampers typically range from 6 to 20 tons and are dropped from heights of about 40 to 80 feet.

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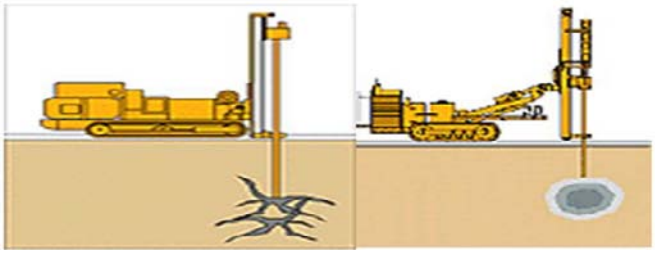
MACHINE WITH TAMPER

COMPACTION BY TAMPER

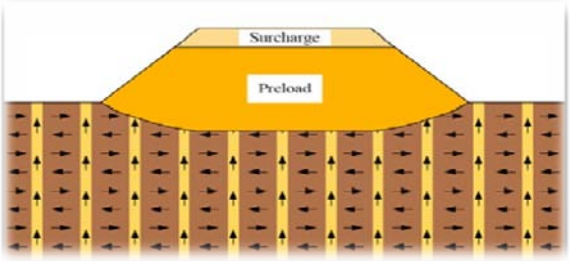
GROUTING: Grouting is a process of ground improvement attained by injecting fluid like material into subsurface soil. Grouting is the injection specially formulated cement of stable suspensions or liquid into pores, fissures or voids, or the jetting of cement mixtures at high flow rate and pressure into the soil to create soil- cement to increase the strength. Material used for Grouting: Cement grouting, Bituminous grouting, Chemical grouting, Polymer grouting

JET GROUTING: It is a technology in which high- pressure jets of cement grout are discharged sideways into the borehole wall to simultaneously excavate and then mix with the soil.

The outstanding feature of jet grouting is the ability to treat a whole range of soils, from silty sands to cohesive deposits, by means of simple cement grouts. Jet grouting can be performed in soils with a wide range of soils and permeability.



PRELOADING: Preloading is the process to apply surcharge load on to the ground to consolidate the soil by removing pore water over time. Pour water dissipation reduces the volume which causes settlement of soil. The temporary surcharge applied on ground is generally more than the expected bearing capacity. Preloading has been used for many years without change in the method to improve soil properties. Preloading is an economical method for ground improvement. However, the consolidation of the soils is time dependent, delaying construction projects making it a non-feasible alternative.



REINFORCED EARTH: In this method soil is stabilized by introducing thin strips such as thin metal strips or geosynthetics mesh .The mesh are parallel to each other and are connected to a barrier to keep soil contained. Barrier is extended into the backfill to prevent overturning and is made up steel, aluminum reinforced or plastic. Galvanized steel strips are used as reinforcement with 50-100 mm wide and several meters in length.

LIME STABILIZATION: Lime stabilization is economical method of stabilization and done by adding lime to soil. Lime stabilization is used for clayey soil and is not effective for sandy soils .The reaction is very quick and stabilization of soil starts within few hours. Quicklime is immediately hydrated and releases heat. Due to heat water evaporate which present in soil and soil are dried. There is considerable saving on aggregate in this method.

CEMENT STABILIZATION: Cement is the oldest binding agent since the invention of soil stabilization technology in 1960's. Cement reaction is not dependent on soil minerals, it react with water which available in any soil called cement hydration. It is ideal for granular soil mixed with fines will require less amount of cement. A well graded sandy soil require 5% cement, whereas poorly graded about 9%, for clayey soils 13% may be required. Admixtures such as lime, calcium chloride, sodium carbonate can also be used.

GEOTEXTILES: Geotextiles are widely used for Road works, Ground system, Hydraulic work, drainage/filtration, waste disposal, construction. Geotextile are any permeable, synthetic, textile material used with foundation, soil, rock, earth, or any other geotechnical engineering related material as an integral part of a man-made project, structure.

SOIL NAILING: Soil Nailing is an in situ technique for reinforcing, stabilizing and retaining excavations and deep cuts. Soil nail components may also be used to stabilize retaining walls or existing fill slopes (embankments and levees); this is normally undertaken as a remedial measure. Since its first application using modern techniques in Versailles in 1972, soil nailing is now a well-established technique around the world. One of the first national guideline publications for soil nailing was produced in Japan in 1987. The U.S. Federal Highway Administration issued guideline publications in 1996 and 2003.The most favorable conditions for soil nailing are as follows: The soil should be able to stand unsupported one to two meters high for a minimum of two days when cut vertical or nearly vertical. Also all soil nails within a cross section should be located above the groundwater table.

FREEZING: On freezing, water expands in volume by about 9%. Reducing temperature till freezing point at which pore water freezes and soil is stabilized. The strength is achieved depends on freeze

temperature, moisture content and the nature of soil. This method is costly to maintaining a low temperature.

HEATING: Heating process of clay soil evaporates water which presents in soil mass increase strength. Heat treatment of a clay soil to about 100 degree Celsius the absorbed water is driven off further increasing strength and 400 degree Celsius makes it non expensive and hard durable.

III. CONCLUSION

Soil conditions can be frequently be improved using soil improvement techniques. A variety of soil improvement techniques have been developed. However a suitable technique has to be adopt according to the soil type, necessity of the structure and economy.

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