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Dynamic compaction and replacement

Cost effective ground improvement method for use in various soil conditions.

Geotechnical solutions for the construction industry

Introduction

Dynamic compaction (or dynamic consolidation) is a ground improvement technique which involves the use of freefalling weights (or pounders) to improve the density, bearing capacity, stiffness and liquefaction resistance of granular soils. The choice of pounder and drop height depends on site conditions, compaction depths and materials to be compacted. Improvement depth of up to 12m can be achieved using dynamic compaction to provide allowable bearing pressures of up to 300kPa and settlements of 10-20mm for conventional structures.

For soils not suitable for compaction, dynamic replacement can be used. Dynamic replacement is a variation of the technique whereby selected material is driven to partially or completely displace the in-situ material to form columns of compacted material which transfer the load to underlying more competent horizons. A surface blanketing layer consisting of compacted selected material is required to effectively transfer load to the compacted columns.

Benefits

Dynamic compaction/replacement is one of the most cost-effective ground improvement methods available. The technique can be used in a large variety of soil types, including rock dumps, uncontrolled fills, waste disposal sites where conventional piling or ground improvement techniques cannot be practically implemented.

Applications

Dynamic compaction/replacement can be used for a variety of structures such as commercial/ residential buildings, warehouse and industrial structures, storage tanks, wind turbines, or any structure where foundation pressures can be practically limited to 200-300kPa.

The technique can be used to pre-collapse soils with unstable soil structures, or to reduce liquefaction potential of liquefiable soils.

Dynamic compaction can also be used in karst conditions where there's a risk of sinkhole formation and to repair a sinkhole that's already formed by constructing a compacted rockfill plug to bridge its throat.

Technical highlights

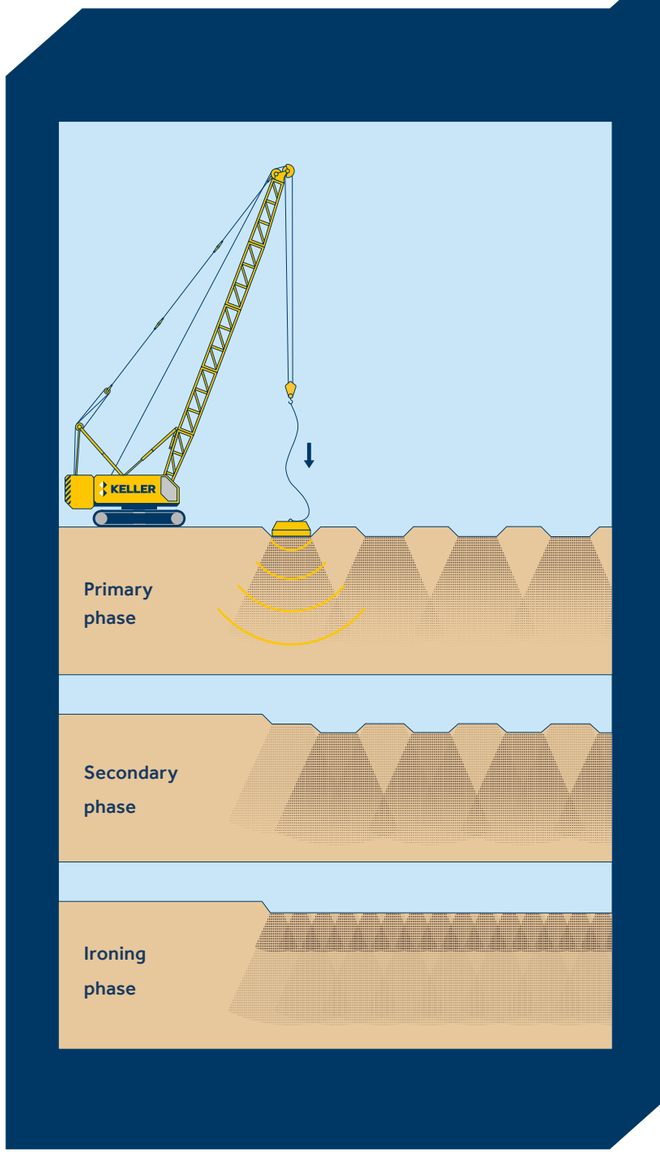
- Cost effective ground improvement method
- Applicable to a large variety of soil types
- Applicable for rockfill, waste dump, uncontrolled fills
- Bearing capacity up to 300kPa
- Treatment depth up to 12m

The procedure

Deep compaction is done initially on a widely spaced grid. This is followed by secondary, closer spaced, drops to compact the intermediate layers of soil. A final shallow 'ironing' compaction is carried out to compact the upper surface soil layer. Phasing of the compaction operation is dependent on soil type, in-situ moisture content and groundwater conditions. A continuous compaction operation can be carried out on partially saturated soils above the water table, but recovery periods may be required between compaction phases for saturated or clayey soils with low permeability.

Quality assurance

Improved soil properties are verified using plate load tests and penetration tests to ensure the required improvement is achieved. In addition, pre-construction and full-scale field tests are often carried out to verify design assumptions and finalise energy input, layout and phasing of production work. Where penetration tests are impractical (such as rockfill or waste dump sites), surface wave testing can be used to estimate the properties of improved soil mass.



Suswa substation, Kenya

Franki Africa, a Keller company, provided dynamic compaction for the Suswa Substation which forms part of the Eastern Electricity Highway Project connecting power grids of Ethiopia and Kenya.

Design and construction of 100 000sqm of dynamic compaction was carried out to improvement depths of between five and eight meters and to meet specified bearing capacities of 150kPa and Young's modulus of 35Mpa.

The dynamic compaction was completed in a period of seven months and provided significant cost and program benefits for the project.

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