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The Specifics of Compaction of Backfill Soils in Cramped Conditions

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Backfill compaction is difficult (in many cases, the operation of machines used for wide frontage works is prohibited), as are places with limited frontage works, as defined by the presence of various utility pipes, tunnels, underground structures, basements, and equipment foundations with varying levels of installation, all of which preclude the use of high compaction loads.

Backfill compaction was the subject of a questionnaire survey of roughly 200 construction companies [1]. When backfilling, 33 percent of construction companies do not compact the soil at all. As required by BC, 15% of construction companies employ expensive and rare imported road building materials for backfill (sand, gravel, crushed stone, rocky soil, slag, etc.).

Backfilling with such materials without compaction, on the other hand, does not prevent future damage to subsurface structures due to uneven settlement. Instead of mechanically compacting cohesive soils (which make up around 70% of all soils in our nation), 15% of construction companies employ soaking to compact soils, which does not give the required density of soils according to the design. Only 17% of construction companies use special compaction machines; instead, they use available vehicles (tractors, bulldozers, loaded dump trucks, etc.) to compact the soil, which does not produce an adequate and uniform depth of soil density. Only 8% of construction enterprises use backfill layer-by-layer technology, instead compacting the earth with homemade heavy, free-falling rammers weighing 3 to 5 tons. They're thrown from a rope excavator's boom (crane). Foundations move, utilities collapse, and excavators and cranes' service lives are decreased as a result of the high dynamic stresses on the ground. Only the top layer of the backfill is compacted in this manner, leaving the below layers uncompacted, resulting in later extensive and erratic settling.

About 5% of construction businesses employ reinforced concrete slabs instead of compacted ground in residential and public structures, as required by BC, resulting in excessive metal and cement consumption.

According to the study results, producing organizations violate the BC in the vast majority of situations (up to 90%). Only 16 percent of construction companies employ the compaction equipment that is available. As a result of poor backfill soil compaction in congested situations, significant and uneven settlements occur, leading in the destruction of man-made structures, technological equipment foundations, soffits, road surfaces, pavements, and other structures.

Compaction of soils in confined spaces is defined by the following characteristics:

- limited ability to use mechanization for backfill construction and levelling;

- different heights of the parking heights of the compaction machines and the compacted surface;
- the difficulty of ensuring a constant thickness of the backfill layer;
- difficulties in levelling the backfilled soil prior to compaction and therefore the need to adjust the machine tool to the unevenness of the compacted surface;
- compaction close to the structure, where the weight of the machine tool must be limited and the force exerted can be adapted to the working conditions;
- limited movement of the base machine, which leads to its positioning work (with the implement being repositioned);
- limiting the overall dimensions of the implement when working in tight spaces narrow places;
- poor visibility of the surface to be compacted by the machine operator (e.g. when compacting deep pits or trenches).

Based on the analysis of the above, it can be concluded that for compaction of backfill soils in cramped conditions, it is possible to use a range of mass-produced and experimental machines with their own advantages and disadvantages.

However, suspended vibratory rammers can be considered the most rational machines for compacting backfill soils in cramped conditions, as they have a number of advantages, such as small size, possibility of changing the force effect, etc.

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