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EARTH DRILL WITH STORAGE UNIT FOR EXAMINATION OF SOILS IN HORIZONTAL ALIGNMENT OF ROADS

The article considers the design of earth drill with storage unit for examination of soils in horizontal alignment of roads allowing to improve process of ground drilling and sampling for researches. Currently, drilling can be performed both by hand drills and machine-driven ones. One of the drawbacks of such drilling is hole sloughing when extracting drill. In order to avoid this problem, the article describes a new design of earth drill with storage unit.

Introduction. Geological engineering survey in horizontal alignment of road is being made to obtain required original material for design, construction and maintenance of roads. The content of geological engineering survey is prescribed by performance specification considering complicity of geological engineering environment, logging enterprise capacity and design peculiarities of the future road.

The performance specification stipulates the following types of geological engineering examinations: collecting, analyzing developed land according to the surveys of past years, researching data about road construction and road maintenance experience; engineering survey of horizontal alignment of road , the industrial areas, bridges; exploratory and experimental work; laboratory investigations; cameral treatment of material and engineering report.

Main part. Geological engineering work surveying forest roads comprises: route engineering survey; examination of areas with deep excavating, high banks, mountain plots, swampy planes, bridges and investigation of road-building deposits.

Field investigation of soils require the following kinds of work: clearings, exploratory ditches, holes, semiholes, heelings, pits, tunnels, drill holes probing.

Boring is made by special drilling ends: a coil, a spoon, a tubular drill, a straight bit.

At field investigation of soils the following documentation is needed: a driller's log or digging log being the primary document, geological columns (Fig. 1), the schedule of borehole cavities; geological engineering records (Fig. 2); the report (explanatory note).

Geological engineering record represents a vertical section of soil columns which bedding is put on drawings infixed) scale. It displays subsequence of rock bedding, sustainability of layers, bounds between separate layers and their soils.

Examining horizontal alignment of road there have been made a simplified engineering cut which is put on longitudinal profile of the road being designed.

Road construction and maintenance require a number of natural building materials: rock, sand, rubble, gravel etc. Exploration activities are carried out along horizontal alignment of road. Exploration activities are carried out simultaneously with a horizontal alignment. Thus approximate volume of deposits, reserves and economic feasibility of its development has been determined [2].

Section	Ground depth, m	Type of ground and its description
	0.5	Light sand clay, medium density
	0.97	Medium sand, medium density, wet at 1.4 m depth, water-saturated
	0.53	Heavy loam, grey-yellow, stiff, wet

Fig. 1. Geological column

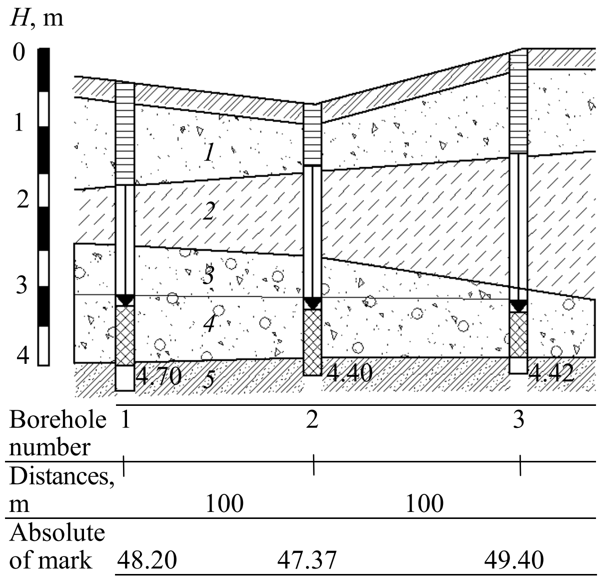

Fig. 2. Geological engineering section:
1 – medium-grained sand; *2* – light sandy loam;
3 – close-grained sand with pebble;
4 – groundwater level; *5* – pulverescent sandy loam

Economic feasibility of digging is determined under the ratio of overburden operations to power of useful material. For this purpose geological quotient is calculated:

$$k_r = \frac{H_1 + H_2}{h_1 + h_2},$$

where H_1 – overburden, a layer of soil ("empty" rock) over a mineral (gravel, rock etc.), m; H_2 – depth of an interlayer of barren rock, m; h_1, h_2 – depth of useful rock (rocks, gravel, etc.).

If $k_r < 1$ – deposit is recommended for development.

Examination of horizontal alignment of road is made by means of both hand drills and machine-driven ones.

The bore for drilling soil holes consists of a vertical bar with a hand lever in a top (for driving gear implementing manual operations) and a cutting knot in lower part consisting of ripper in the form of a flat drill and screw for transferring loosed ground in vertical direction. After accumulation of a sufficient volume of soil the drill is extracted from a bore hole and soil is shaken off a feed screw. When fulfilling this operation a part of loosed soil, specially sandy, is poured revertively in a bore that reduces process effectiveness. For elimination of this lack we have developed a construction of earth drill with storage unit.

In the designed construction the additional cylindrical bowl is installed above a feed screw, the storage unit rigidly fixed on a bar prevents spontaneous pouring of soil into a borehole. After extraction of a bore from soil it is necessary to displace a bar into horizontal state or at the angle more than 90 ° for storage unit discharging , that requires extra force and time.

To increase efficiency of drilling operations by means of the developed design of hand drill (as opposed to the existing (described) one): the circular storage unit connected to a bar with hinge joint, and along a cylindrical surface storage unit there have been made a groove having bigger diameter than a bar that ensures an angular displacement of the storage unit regarding to a bar. The construction of earth drill with storage unit is introduced in Fig. 3.

A bar consists of several parts *1*, *3*, interconnected by means of a threaded knot *2*, on a bar top the bracket *4* for hand lever *5*, a screw *6* for lever fixation, a threaded joint *2* with interior *7* and external 8 thread, a collar *9* with thread for is welding screws *10* ensuring hinge joint of storage *11* with diameter *D* with a bottom a bar *1*, screws *10* are located above the upper flight screw at the height more than radius R cutting edge *12* of storage, a feed screw *13*, the ripper *14* in the form of a flat drill.

In Fig. 4, 5 storage position is shown when despoiling.

The assembled earth drill operates in the following way. In a place of drilling and sampling, ripper) *14* is dented into soil by means of lever *5* and rotary motion by hand-carry goes deep into soil with force commensurable with physical capabilities of the worker. Loosened soil (by the ripper *14)* moves up (on a feed screw *13*) and further is collected into storage unit *11,* then it is extracted from a borehole by vertical motion. Without the storage unit soil was on an auger surface *13* and at extraction from a borehole was partially poured back into a hole. The storage unit holds soil on the upper twist of an auger surface in a cylindrical volume of the storage unit and prevents it from pouring back, thereby increasing overall performance of the device.

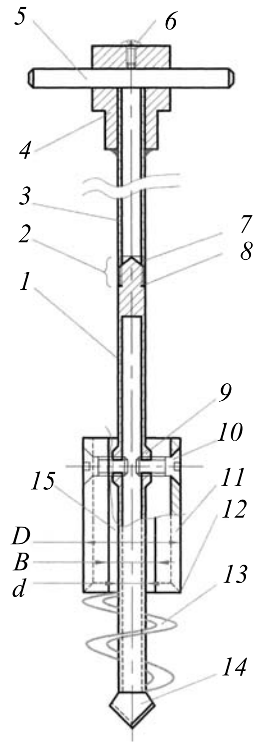

Fig. 3. A construction of earth drill with storage unit

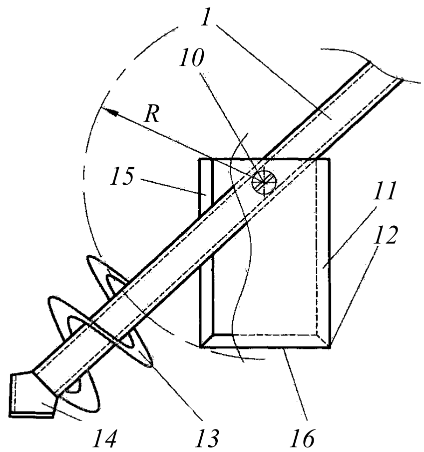

Fig. 4. Earth drill with solid cutting edge

After extraction from a borehole bar is inclined at horizon angle, and hinge connection on screws *10* ensures storage unit *11* transfer to vertical plane regarding to horizon (Fig. 4). The groove on a side cylindrical surface of the storage unit is made with width *B*, larger diameter then of a bar *d*. It ensures a larger angle of storage unit rotation regarding to a bar and easies desoiling from it.

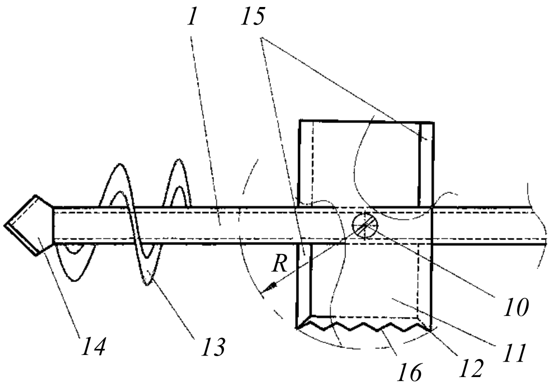

Fig. 5. Earth drill with teeth cutting edge

With clay soil it is necessary to ensure a larger angle of storage unit rotation, it results from groove on a side cylindrical surface of storage unit being made from two counter parties on half of storage unit height, correspondently in top and bottom parts (Fig. 3).

To reduce the force of drill rotation there is a solid (Fig. 4) or dentate (Fig. 5).cutting edge *16* at on the cross-cut end of the storage unit.

After storage unit desoiling the bore returns in a vertical position, further work cycle is done and then repeating until obtaining borehole of required depth.

To make boreholes with depth more than a bar length, the additional extender is rolled into threaded unit 2. The storage unit is removable, and operations can be done without it (if necessary).

In non-assembled state the bore is compact and convenient to transport and use in field conditions.

Conclusions. 1. The designed construction of a bore with relieving storage unit, holding soil from pouring at its extraction easies desoiling the storage unit after working cycle, that considerably increases operation effectiveness when surveying and examinating soils on a horizontal alignment of roads.

2. The relieving storage unit increases operation efficiency when drilling boreholes in granular soil due to prevention its pouring into borehole while extracting.

3. The designed earth drill with storage unit is recommended not only for examination of soils on horizontal alignment of roads, but also for other types of activities where it is necessary to know layer-specific bedding.

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