DETERMINATION OF THE STRENGTH OF SOILS OF THE REGION WHEN OPERATING ENGINEERING MACHINES

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Abstract: *as you know, performing work in soils with increased strength is more laborious and expensive, requiring preliminary loosening. Performing engineering tasks in such conditions not only causes a decrease in the productivity of machines and equipment, but also significantly limits the possibility of their use. For this reason, the correct determination of soil strength using a unified method is relevant.*
The article presents the results of research on the determination of probabilistic models of the laws of soil distribution and the general ground background in terms of moisture, taking into account the change in the latter during the year, of various types of soils throughout the republic.
Keywords: *engineering technology, soil strength, dispersion of distribution, soil background, intensification of working bodies, sandy loam.*

ОПРЕДЕЛЕНИЕ ПРОЧНОСТИ ГРУНТОВ РЕГИОНА ПРИ ЭКСПЛУАТАЦИИ ИНЖЕНЕРНЫХ МАШИН

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Аннотация: *как известно, выполнение работы в грунтах с повышенной прочностью является более трудоемким и дорогостоящим, требующим предварительного рыхления. Выполнение инженерных задач в таких условиях не только вызывает снижение производительности машин и оборудования, но и значительно ограничивает возможность их применения. По этой причине правильное определение прочности грунта по единому методу является актуальным.*
В статье приведены результаты исследований по определению вероятностных моделей законов распределения грунтов и общего грунтового фона по влажности, с учетом изменения последней в течение года, различных типов грунтов по территории республики.
Ключевые слова: *инженерная техника, прочность грунта, дисперсия распределения, грунтовой фон, интенсификация рабочих органов, супесь.*

One of the conditions for the efficient operation of engineering machines is the condition of the facility (land plots) where it is planned to carry out earthworks. It is not uncommon to have to choose the type of engineering machine, in particular, machines for earthworks, depending on the strength of the soil mass. Usually, with high strength of the developed soil, basic equipment with a higher traction class and with toothed working bodies is used.

In addition, the performance of work in soils with increased strength is more laborious and expensive, requiring preliminary loosening. Performing engineering tasks in such conditions not only causes a decrease in the productivity of machines and equipment, but also significantly limits the possibility of their use. For this reason, the correct determination of soil strength by a unified method has always been relevant [1].

The strength of soils is characterized by the ability to resist external forces.

One of the attempts in this area was made by prof. A.I. Zelenin, who suggested using the DorNII striker for this purpose, which is a rod with a tip 10 cm long and a cross-sectional area of 1 cm^2. A load weighing 25 N freely moves along a rod 0.4 m long. The load, falling from a height of 0.4 m onto the shoulder, performs work, for each fall equal to 10 N. The number of falls required to immerse the plane of the cylindrical tip into the ground to a depth of 10 cm, is called the number *C* [2].

When working in especially weak soils (sand, arable soil, etc.), a tip with an area of 1 cm^2 is replaced with a tip with an increased area, for example, 10 cm^2. Such a tip is immersed to a depth of h = 10 cm in approximately 10 strokes where a tip with an area of 1 cm^2 has C = 1. When increasing the area of the tip, it is necessary to take into account the value:

$$n = \frac{E}{F} = 10 \text{ H / cm}^2, \qquad (1)$$

where E is the impact energy;

F is the tip area.

The formation of statistical models of operating conditions for the strength of soils requires the determination of the laws of their distribution in terms of moisture and the number of blows from the DorNII density meter.

However, it should be noted that the assessment of soils by the number C at a specific point in time does not yet represent a real picture of changes in strength properties, since they change throughout the year depending on the moisture content of the soil massif, as well as the depth [3].

Therefore, it is recommended to establish the distribution of the index of strength properties of soils through the laws of moisture change in an annual mode.

The natural and climatic conditions of the environment during the year determine the change in the moisture state of the soil massif, that is, the amount of precipitation, the temperature of the air and soil, the direction, strength and duration of the wind, the type and water-physical properties of the soil, as well as the terrain.

To determine the annual moisture regime of the soil, statistical data from agrometeorological stations of the Center for Hydrometeorological Service under the Ministry of Emergency Situations of the Republic of Uzbekistan were used.

A soil sample for weight moisture was taken at 60 experimental plots, evenly located on the territory of the republic, every month every 10 cm to a depth of 1.0 - 1.5 m. For the calculation, data from samples taken outside the irrigated lands were used in order to exclude the effect of irrigation on moisture soil.

As a result of processing the raw materials, the laws of soil moisture distribution (w) and their numerical characteristics were established. The hypotheses put forward were tested using the Pearson's goodness-of-fit test.

$$w = \frac{\sum_{j=1}^{l} m_j w_j}{N}, \qquad (2)$$

where w_j – is the average value of the random value of humidity in the j-th interval (interval average);

m_j – statistical frequency, that is, the number of observations in the j-th interval;

N – is the total number of observations;

The basis for accepting the proposed null hypothesis is its compliance with the goodness-of-fit criteria, in this case, the presence of the ratio

$$\chi^2 < \chi^2_{\alpha;k} \qquad (3)$$

where χ^2– statistics or Pearson test;

α – significance level, usually taken α = 0.05;

k – the number of degrees of freedom, which is determined by the formula:

$$k = l - (d + 1), \qquad (4)$$

where l – number of intervals;

d – the number of parameters of the theoretical distribution.

As a result of processing the collected data by methods of mathematical statistics, the hypotheses of the distribution laws were adopted.

The obtained distribution laws are as follows: for the general ground background of the republic and for sandy loam - the Weibul distribution

$$f(w) = n\,\psi^n\, w_i^{n*1}\, e^{-\psi^n * w_i^n}, \qquad (5)$$

where w_i – random humidity value;

n, ψ – parameters of distribution laws.

The value of the mathematical expectation and the root-mean-square deviation of the moisture distribution of the "average" soil (from the general soil massif) turned out to be respectively equal to 12.74% and 6.39%.

Thus, probabilistic models of the laws of soil distribution and the general ground background in terms of moisture have been determined, taking into account the change in the latter during the year, of various types of soils throughout the republic.

The data obtained can be used in the selection of the appropriate types of engineering machines for performing earthworks in areas with different soil strengths.

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