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FOR THE DESIGN AND CALCULATION OF FILTRATION BEAMS IN CONCRETE LINERS OF THE PRESSURE SLOPES OF EARTH DAMS

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ABSTRACT

The results elucidate that the effective stress of the upstream embankment materials increased because of the undrained shear behavior of the compacted soils, although the deformation on the upstream side was larger than that on the downstream side. A large phase difference in the measured accelerations between the upstream slope and the downstream slope was also observed. Therefore, it is concluded that significant differences occurred in the dynamic behavior of the upstream side and the downstream side.

Keywords: *Small earth dam, Full-scale shaking table test, Geosynthetic clay liner, Residual deformation, Excess pore water pressure.*

ANNOTATSIYA

Natijalar shuni ko'rsatadiki, oqimning yuqori qismidagi deformatsiya quyi oqimdagiga qaraganda kattaroq bo'lsa-da, siqilgan tuproqlarning drenajsiz siljish harakati tufayli yuqori oqimdagi qirg'oq materiallarining samarali kuchlanishi ortdi. Yuqori oqim va quyi oqim o'rtasidagi o'lchangan tezlanishlarda katta fazalar farqi ham kuzatildi. Shu sababli, yuqori oqim va quyi oqim tomonlarining dinamik xatti-harakatlarida sezilarli farqlar yuzaga kelgan degan xulosaga keldi.

Kalit so'zlar: *Kichik tuproqli to'g'on, to'liq miqyosda chayqaladigan stol sinovi, Geosintetik gil qoplamasi, Qoldiq deformatsiya, Haddan tashqari g'ovak, suv bosimi.*

АННОТАЦИЯ

Результаты показывают, что эффективное напряжение материалов насыпи выше по течению увеличилось из-за недренированного поведения сдвига уплотненных грунтов, хотя деформация на стороне выше по течению была больше, чем на стороне ниже по течению. Также наблюдалась большая *разность фаз в измеренных ускорениях между наклоном вверх по течению и склоном вниз по течению. Таким образом, делается вывод о значительных различиях в динамическом поведении стороны вверх по течению и стороны вниз по течению.*

Ключевые слова: *Небольшая земляная плотина, Полномасштабное испытание на вибростенде, Геосинтетическая глиняная подкладка, Остаточная деформация, Избыточное поровое давление воды.*

INTRODUCTION

It is known that the fastening of the pressure slopes of earthen dams work in conditions of a variable hydraulic regime and a changing hydrogeological situation. And as experience has shown in the operation of earthen dams of reservoirs in Central Asia, cracking and destruction of linings took place in the slope supports under the action of a weighing filtration pressure.

Therefore, in order to ensurereliability of the fastening on the perception of the main loads acting on the cladding at their most disadvantageousIn combination, its design was improved, which is a lining of monolithic concrete slabs with embossedinto it with filtration cups laid either directly on the earthen slope or on the sand and gravel preparation.

In earthen dams built of fine sand without gravel-pebble prisms (occurring in Central Asia), the pressure slope is fixed in the form of reinforced concrete slabs of large sizes (10x10 and even 20x20 m) with construction joints through 2.5 and even 5, 0. Expansion joints are made blind with a width that ensures free deformation of the slabs during the settlement of the dam and jamming of the bituminous mastic.

The preparation under the slabs is selected according to the granulometric composition from the sand-gravel mixture and calculated by the thickness. It should ensure the dynamic stability of the soil of the slope of the dam, exclude its suffusion and, in general, guarantee the free exit of seepage water into the reservoir through a filter located at the bottom of the slope. Moreover, this filter must be protected from silting and sedimentation by the longitudinal coastal movement of the turbid stream.

Filtration cups hammered into the concrete lining should provide a quick and organized exit of filtration water from under the plates without soil suffusion and a decrease in the filtration pressure during a sharp drawdown of the water level in the reservoir.

We have developed a new design of lining with filter cups and obtainedpatent [1] which allows to provide an organized exit of seepage water during drawdown of the water level in the upstream with a given flow rate from under the concrete lining to its surface and reduce the weighing water pressure on the lining itself to acceptable values and exclude suffusions in soils. These conditions must be ensured by sufficient sizes of glasses and their number in the area under consideration. The exclusion of suffusion of the material of the dam body, impervious elements, as well as the loading layer is ensured by the correct selection of the material of the cup filters.

The need for installation of filtration cups should be established according to the criteria of the permeability of the material of the dam body or its impervious elements and the given mode of operation of the reservoir according to the characteristics.

$$\Pi = \frac{KT}{\mu} \leq 200[\text{ m }](1)$$

where $\mu$is the coefficient of water loss of the soil of the body or impervious element of the dam;

K – soil filtration coefficient of the dam body (m/ day);

T is the drawdown time of the water level in the reservoir.

At P >200m, filter cups should not be made , because when the water level in the reservoir (WWW) draws down , the weighing pressure under the lining will not be formed due to the free outflow of seepage water.

The number of sleeves is set depending on the permeability and size of the loading layer under the lining, the rate of air-blast reduction, the laying of the upper slope and the dimensions of the effective section of the sleeves

The expediency of the arrangement of glasses is characterized by the criteria

$$\frac{K}{\delta} \geq 50[\text{ day }](2)$$

where K is the filtration coefficient of the loading layer of the dam slope

δ - surcharge thickness

So, with a decrease in air-blast, the total working area of the effective section of the cups decreases, it is necessary to change the density of the network, increasing the number of cups in the lower part of the cladding. In this case, the cladding should be divided into three zones according to the height of air-blast drawdown .

The area of the open section of the glasses in one horizontal row of concrete lining is calculated according to the dependence

$$\Omega = \alpha\delta\ell n^2 \frac{\vartheta}{Ki^2} \qquad (3)$$

where $\alpha$is the coefficient taking into account the zoning of the glasses location (for zones I- α=1.05; II- α=0.7 and II- α=0.5) ;

ℓ- length along the front (m);

n - porosity of the loading layer (in fractions of a unit);

ϑ – air-blast reduction rate

i– seepage water pressure gradient under load (depends on the magnitude of the upper slope of the dam " m" and is taken equal to

$$i = \frac{1}{\sqrt{m^2+1}} \quad (4)$$

The filtration coefficient of the surcharge material can be determined empirically or calculated from an empirical dependence with a known particle size distribution:

$$K = \frac{3{,}99}{\nu} \sqrt[8]{\eta} \frac{n^8}{(1-n)^2} D_{17}^2; \text{ см/с} \quad (5)$$

η- coefficient of inequigranularity of mater and ala surcharge ;

D_{17}- the diameter of the soil particles of the surcharge , less than which its composition contains 17% by weight;

ν- coefficient of kinematic viscosity of water cm ^{2}/ s (at water temperature T \u003d 10 ^{0} Cν\u003d 0.0131 cm ^{2}/ s).

surcharge porosity coefficient is calculated according to the dependence

$$n = \frac{0{,}63}{\sqrt[6]{\eta}+0{,}63} \quad (6)$$

<u>An example of calculating the number of glasses in the upstream slope of reservoirs .</u>

and similar data. The loading layer of the upper slope of the dam is made of sand-gravel-pebble soils. Its thickness is δ = 2m. the particle size distribution curve has the following characteristics: D_{10}=0.012 m, D_{17}=0.035 cm, D_{60}=2.2 cm,

$\eta = \frac{D_{60}}{D_{10}} = 183$Top slope laying m= 3

Glasses are made of round section with a diameter of 0.3 m.

Determine the number of glasses by zones per unit area of the lining, the component along the length along the dam ℓ = 100r.m. and air- blast drawdown depth h = 20 m, if air-blast reduction rate is v = 1 m/ day .

We establish the expediency of the arrangement of glasses according to the criterion

To determine the filtration coefficient, we find the value of porosity according to dependence (6)

$$n = \frac{0{,}63}{\sqrt[6]{183} + 0{,}63} = 0{,}23$$

From dependence (5) we determine the filtration coefficient of the surcharge material

$$K = \frac{3{,}99}{0{,}0131}\sqrt[6]{183}\frac{0{,}23^3}{(1-0{,}23)^2}0{,}035^2 = 0{,}21\text{см/с}\text{=182 m/day.}$$

Finding a criterion $\frac{k}{\delta} = \frac{182}{2} = 91$ сут

What is within the allowable values (>50). Therefore, the installation of glasses for this dam in order to unload seepage water from under the lining will be appropriate.

We divide the surface of the cladding into three zones.

The length of the lining along the transverse profile of the dam within the prism of air- blast drawdown (h = 20 m) will be

$$\ell_1 = \sqrt{m^2+1}h = \sqrt{3^2+1}\cdot 20 = 63{,}2 \text{ м}$$

The dimensions of each of the 3 cladding zones are taken equal to $\frac{\ell_1}{3} = 21$м

The pressure gradient of filtration water under the cladding is found from the dependence

$$i = \frac{1}{\sqrt{m^2+1}} = \frac{1}{\sqrt{3^2+1}} \cong 0{,}32$$

We determine the area of the living section of the glasses in a horizontal row at a length of ℓ = 100p.m. by addiction

For zone I (lower)

$$\Omega_1 = 1{,}05 \cdot 2 \cdot 100 \cdot 0{,}23^2 \frac{1}{182 \cdot 0{,}32} = 0{,}6\ m^2$$

For the middle (II) and upper (III) zones, the area of the glasses will be, respectively: Ω_2 \u003d 0.4 m ^{2} and Ω_3 \u003d 0.29 m ^{2}

The horizontal distance between the glasses is assumed to be the same and calculated from the dependence

$$\alpha = \frac{\ell\omega}{\Omega}$$

g de $\frac{\Omega}{\omega}$- number of glasses horizontally

The area of \u200b\u200bthe living section of the glasses in our $\omega = \frac{\pi d^2}{4}$case will be $\omega = \frac{3{,}14 \cdot 0{,}3^2}{4} = 0{,}07$ m ^{2}

Having found the number of glasses horizontally for each zone (I-9, II-6, and III-4 glasses) we determine the step between them $a_1 = 2$ м,$a_2 = 17$ м, $a_3 = 25$ м.

Along the normal to the axis of the dam , the step between the glasses "b"will be taken from the calculated air-blast reduction rate:

at v= 1.0-1.7 m/ day$b$=5 m;

v= 0.5-1.0 m/day b= 7 m;

v= up to 0.5 m / day b= 10 m.

The number of glasses by zones is set after determining the size of the zones and the distances between the glasses

In our case, we take the distance between the glasses along the normal to the axis of the dam equal to b= 6 m.

In each zone I-III we install a $\frac{\ell}{3b} = 3$ number of glasses.

The number of glasses by zones will be:

$$1 - \frac{\Omega}{\omega} \cdot \frac{\ell_1}{3b} = 9\text{х}3 = 27;\ \text{II} - 18\ \text{иIII} - 12\ \text{стаканов}.$$

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