ISSN 2227-6920

Research Bulletin SWorld

Modern scientific research and their practical application

Published by:

Kupriyenko SV *on* ***Project SWorld***

With the support of:

Odessa National Maritime University

Ukrainian National Academy of Railway Transport

Institute for Entrepreneurship and morehozyaystva

Lugansk State Medical University

Kharkiv Medical Academy of Postgraduate Education

Volume J11404

May 2014

SWorld /*Scientific World*/- is a modern on-line project, acting in the name of science to achieve the high goal "international integration of research" (conferences, workshops, electronic journals, publishing support for academics)

Please use the following format to cite material from this book (*italics indicate the fields to change to your data*):

Author(s), 'Title of Paper," in Modern scientific research and their practical application, edited by Alexandr G. Shibaev, Alexandra D. Markova.Vol.J11404 (Kupriyenko SV, Odessa, 2014) – URL: http://www.sworld.com.ua/e-journal/j11404.pdf (date:...) - *Article CID Number*.

This volume contains research papers of scientists in the field of Arts, Architecture and Construction.

Published by:

Kupriyenko SV
*on **Project SWorld***
P.O. Box 38, Odessa, 65001Ukraine
Telephone: +380667901205
e-mail: orgcom@sworld.com.ua
site: www.sworld.com.ua

Paper Numbering: Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first publication.

CONTENTS

J11404-001

Svitlana-Roksolana Oleksandrivna Dudka

ERGO-DESIGN APPROACH TO FORMING OBJECT-SPACE ENVIRONMENT OF RESTAURANT COMPLEX

Summary. The paper considers ergonomic principles and requirements to object-space environment restaurant complex. Optimization of space to achieve greater comfort for vacationers and for working people in an institution. The communication of production facilities with trading rooms, which directly affects the proportions of rooms. Detailed analysis of the accuracy of selection of furniture and functional properties depending on the type and objective functions.

Keywords. Ergonomics, design, interior space, furnishings, elements, organization, optimization, comfort and convenience.

Relevance of the subject. Ergonomics is the science that studies the acceptable physiological, nervous and mental burden on people at work, the problem of optimal adjustment of environmental conditions for effective work. The study of ergonomics and implementation of its foundations in creating interior and forming the object-space restaurant complex spatial environment is quite a burning topic at present.

Object of the study. Ergonomics is the system of "man-machine-environment", i.e. status of the people who work and in catering establishments such as restaurant complex.

The subject of the study. Specific working activity of the person using the machine. Ergonomics considers the technical and human aspects in close connection. The combination of human being abilities and machine capabilities significantly improves the efficiency of functioning. Therefore, solution of applied problems of ergonomics involves movement simultaneously in two directions, toward requirements of a human being to machine and conditions of its functioning and vice versa: the machine requirements and with respect to conditions of its functioning toward a human being.

The purpose of the study. It is a study of the fundamentals of ergonomics and its requirements when forming the object-space restaurant complex spatial environment. Another purpose is creation of ergonomic nature of some elements and objects of interior space and the accuracy of their correct placement and form in the restaurant.

The results of the study. Differentiation of room space can be achieved by applying a single style, but in different shapes and sizes of furniture that present different sets and series of tables, chairs, sofas. Furnishing is one of the most effective means of dismemberment of hall space into separate zones, because depending on how mobile or stationary furniture is used it is possible to change the nature of zoning.

Noticeable effect on the character of the interior was produced by the development of such types of public catering facilities, as youth cafes and evening cafes. In the trading floors of these companies the attendees watch TV programs, relax, read newspapers and magazines, meet friends. These rooms provide leisure areas, tape-recorders, TV sets are placed there. Therefore the nature of the furnishings changes: sideboards were blocked, low benches in combination with flower gardens, occasional tables appeared. The tendency to increase free space of the hall rouse the need for compact placement of equipment, the appearance of built-in furniture.

Of great importance in the development of modern interior has correlation between functional values of its elements. If the architect follows a functional approach to the project, he achieves the integrity of the interior. Efficient organization of production facilities communication with trading halls affects the proportions of rooms. Elementary hygiene requirements determine the prevalence of the highlight tones in decoration of the rooms that creates a sense of space. With a clear functional organization of space and high quality finishing materials small decorative accent is sufficient to make finishing of the interior for it to acquire completed original character.

When planning public rooms what should be taken into consideration is a form of service, depending on which the location of entrances and exits, the aisle size between the tables, their location and other some factors are determined. Acceptable range for layout dining tables constitutes at least 0.6 m between the corners at a diagonal arrangement, if the tables are placed parallel to the wall, the row near the wall is placed close to it, and in this case the distance between the tables should be at least 1.5 m considering convenient location of chairs. Main passages should be at least 1.5 m, branch passages – 0.75 m. However, these distances can be recommended only conditionally, since in each case room furnishing depends on the layout and form of service at the enterprise.

Selection of lighting plays an important role in organization of the interior of a dining room. Increasingly, natural lighting of the hall on one side was changed to double-side, three-side and overhead lighting, thus achieving the bond with the interior of the building surrounding landscape. Methods of artificial lighting are very diverse and should have a direct connection with the furnishing of the hall. In the halls of big restaurants, dining rooms, cafes different systems with evenly diffused lighting in suspended ceiling plane with increased illumination of certain areas (e.g. dance floor, stage) are used in combination with the use of local lighting (boxes, group of tables, etc.). Important tool for spatial decision of interior is its color composition. It is known that cold colors with dominating white visually expand the space of the room, moving the objects away, warm, rich colors draw them nearer. There exist a big variety of the methods of interior color scheme organization. For example, with the dominating neutral colors array of the room the accent can be shifted to furniture upholstery, chairs color; when uniting with one color, such as white, the basic interior elements - floors, walls, furniture - the focus is shifting to the garments of the attendees. In solving the interior color composition, when using different decorative techniques one should not forget about sense of proportion. We know many examples when the desire to use the whole variety of decorative techniques - reliefs, paintings, murals, ceramics, intensive coloring of the walls and floor for room decoration came into opposition to the interior.

Restaurant tables designed to serve with tablecloths, are usually made of wood and have a special design of table tops. Metal base in these tables is rarely used. Tops of these tables are usually are usually glued by cloth or canvas to provide stable position of tableware. However, this method does not adequately address the requirements of sanitation, since spilled drinks and sauces eventually impregnate cloth or canvas. It is expedient to put under the table top the cover made of cord or gum elastic, easy to change and wash. This method is recommended for restaurants, working at day time as dining rooms. Tables of such enterprises are usually covered with plastic and during day time the clients dine without tablecloths, and by the evening the covers are put on the chairs and table tops of the tables are covered with tablecloths.

Banquet table is slightly higher than the normal restaurant one (760-780 mm). In addition, more complicated serving of the table requires bigger width of 950-1000 mm. Buffet tables are used in restaurants mainly for servicing receptions, when the invited people eat and drink while standing. Buffet table is laid in advance. Many dishes with snacks, bottles with drinks, plates, glasses, stemware, flatware, which are put on the table at the same time, require bigger table top bigger than conventional restaurant table tops size.

The optimum width of a buffet table is 1100-1200 mm. The surface of table tops is glued by cloth or the protective cover is applied. Banquet table is covered with banquet tablecloth. Length of buffet table may need a fairly large length (5-10 m), it is therefore appropriate to produce such tables in table sections (1000-1500 mm). Table height is 1000-1050 mm. For the buffet table metal frame structure is used, such as T-shaped metal supports. Tables on four legs have the frame made of square, round or oval tube with diameter 25-30 mm. The usual shape of the tops of such tables is rectangular with dimensions 700x700, 750x750, 800x800, 700x1100 mm. Many models of tables for restaurants have support in a form of a single leg made of steel round (sometimes square) tube with a diameter of 50-60 mm. The top of the pipe is welded to the steel flange or frame and at the base - to the metal cross or pedestal.

Tables with square (600x600 mm or 650x650 mm) table top on a single support with the crossbar at the base are the most convenient for small restaurants. These tables can be used as a two-seat or arranged in rows of any length. Tables on a single support sometimes are produced with a round top. Base made of two T-shaped supports (steel pipe 40-50 mm) can also be used, the length of the horizontal base of this support is 600 700 mm. For the stability of support (especially in long rectangular tables) the elements can be connected by steel side-bar (on welding or screws). The advantage of the frame on one or two supports is to simplify the design of the frame. For example, steel flanges (thickness 5-8 mm, side 200300 mm) welded to the top of the legs are mounted directly to the table top with screws etc.

Tables height for cafe is as stable as in a restaurant or dining room. The cafe often uses low tables (such as youth cafe). Low table does not separate the interlocutors, it helps to create a more relaxed atmosphere, free communication. The minimum height is 690-700 mm. With further lowering table begins to resemble occasional table, divan bed table. In children cafes several types of tables are used: for junior and middle preschool age - a table for two kids with height 540 - '"550 mm with table top 600x600 mm; for senior preschool age (5 -7 years) - table height 570-590 mm for primary school children (8-12 years) - table height 650-680 mm. Adults who came to the cafe with children can also sit at these tables.

Ready-made kits of furniture for restaurants are rarely produced. In each case, the selection of tables and chairs for them is made individually depending on the interior decoration. Best of all, when tables and chairs (armchairs) have frames made of the same material, equally processed and painted.

Conclusion. As you know, in the design of any object convenience of the shape and its beauty are inseparable. Even if one objects is considered by many people "ugly", and the other - "very good" (perhaps claims to be the subject of art), both of them must be utilitarian, of good quality and comfortable.

Ergodesign involves ergonomic pre-project exploration of any object before it is created and it will acquire certain form. One of the criteria of this discipline is intended use of the object, its functionality, appearance (shape plastics, colors and graphic design) as well as the material from which it is made. It all has to do with any household article. "Good design" is possible only after determining its intended purpose, common features of functionally based shape, favorable colors and ecological structure of the material. Finally, after defining all the tasks facing the designer, style decision on a particular product is developed. And the more the ultimate goal - the creation of an object, based on the elements of its design stages, will remain at distance, the more will be the number of future standard errors. At this in the design of each object specific features are manifested.

Reference literature

1. Zinchenko V.P., Munipov V.M. The fundamentals of ergonomics, M.: Publising House of Moscow University, 1979 – 344 p.

2. Makarova M.N. Perspective. Study guide for the students of pedagogical institute in artistic graphics, M.: Prosvescheniye, 1989 – 191 p.

3. Nesterenko O.I. Concise encyclopedia of design, M.: Molodaya Gvardiya, 1994 – 315 p.

4. Antonovich S.A., Vasilishin Ya.V., Shpilchak V.A. Russian – Ukrainian dictionary and reference book in engineering graphics, design and architecture. Study guide – Lviv: Svit., 2001 – 240 p.

31.10.2013

J11404-002

Aldungarova A.K., Kozionov V.A.

PROGRAM OF MODELING OF GROUND DAMS WORK ON UNDERMINED TERRITORIES

L.N. Gumiylev Eurasian National University, Astana s., Munaitpassov str., 5

Abstract. The article describes a technique of physical modeling of groundwater dam on moonlighting basis method of equivalent materials for large-scale laboratory bench with layering body embankment reinforced and unreinforced ways.

Key words: dams, modeling, ground, soil.

Introduction. During the construction and operation of buildings and structures on undermined territories danger significant movement of foundations, which can lead to damage and even destruction of supporting structures. Currently adequately developed methods of calculation and simulation of various types of foundations (belt, bar, pile) buildings on undermined territories [1]. However, their practical use for the analysis of dams in such areas needs further validation and study. This is due mainly to the need to consider the additional stress field arising in the base and the body of the dam at undermining the territory in which it is located.

The aim of this work is to develop methods of physical modeling of the stress - strain state of dams in different variants arising during deformation of the undermining territory.

Modeling method. To achieve the goal of research the method of equivalent materials [2]. This method is not associated with the use of expensive equipment, simple, convenient and offers a wealth of scientific information required in a relatively short time compared with the field the same tests. Using this method of modeling is justified by the fact that under the requirements of the theory of similarity, we can obtain not only qualitative relations, but also some quantitative data that will need to be confirmed by field experiments or modern theoretical methods. Complement physical modeling results of theoretical studies, such as finite element analysis, makes it possible to verify the adequacy of the design model of the dam and foundation in the development of the project and, if necessary, to clarify the scheme and reinforcement parameters mound.

Stand scheme. Stand for simulation (volumetric) deformation model dirt dam (Fig. 1) is in the form of individual sections of channel 1. Between sections 1 fitted elastic rubber gaskets 2 - 10 mm thick. Side shelves stocked trough sections 1 bolting 3 in the upper and lower levels horizontally. The tray has end walls 4. The lower part of channel section 1 is provided with adjustable feet 5 , made in the form of ball bearings mounted on the support frame 6 (Fig. 2) . Stand size is 1600 x 1000 x 250 mm. The design of the stand allows surround a considerable range to create independent tensile strain and curvature, as well as to vary the size of the dam model 7. Choosing the right size based on the results of preliminary calculations. Testing is as follows: using bolting 3 produce compression or stretching of channel sections 1, with whom deformed material in the tray. Horizontal tensile strain ground forces provided by elastic recovery of compressed elastic (rubber) gaskets 2 when loosening of bolted joints 3. Horizontal compressive strain soil provides compression elastic (rubber) gaskets 2 by bolting 3, bring together the sections of channel model 1. Precipitation models mound measured deflectometer, moving the soil surface fixed dial gauge. Horizontal deformation of the base in the process of earning a micrometer determined by measuring the distance between the marks .

Selection of equivalent materials. According to the method of equivalent materials proposed G.N. Kuznetsov [2], according to the characteristics of the mechanical properties and the full-scale model of soil NH and NM can be for a given relationship γM/γH and relationships N_M/N_H calculate the scale of the model. As determined by the physical and mechanical characteristics are taken those characteristics that play in the process leading role. In the selection of materials - equivalent granular soils can, to a first approximation, as the defining characteristics of the clutch and use the values of the angle of internal friction C, φ. To ensure similarity conditions fracture processes here should respect the equality (1):

$$C_m = {}^{I}\!/_{L} \cdot {}^{\lambda_M}\!/_{\lambda_H} \cdot C_H \qquad (1);$$

$$tg\varphi_m = tg\varphi_н \qquad (2);$$

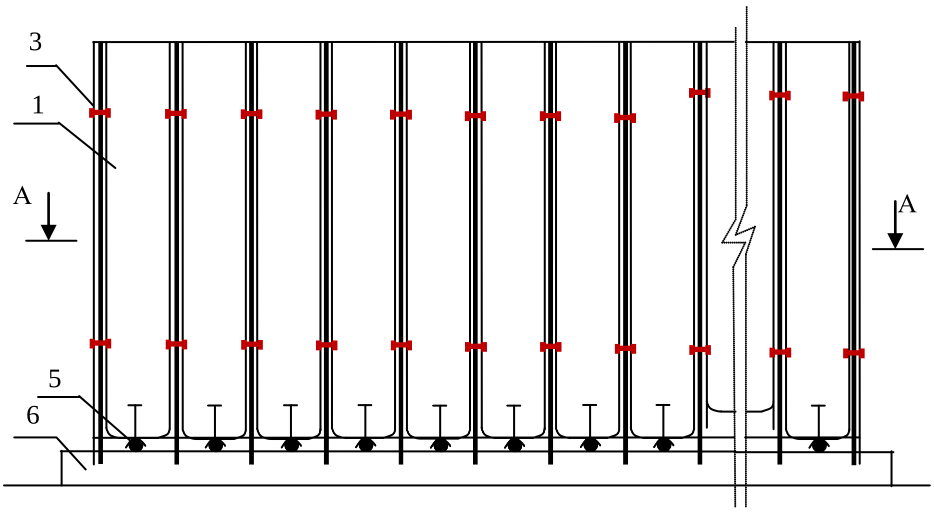
were:

$I / L = m_t$ - linear scale model;

φ_M , φ_N - proportion of material models and nature;

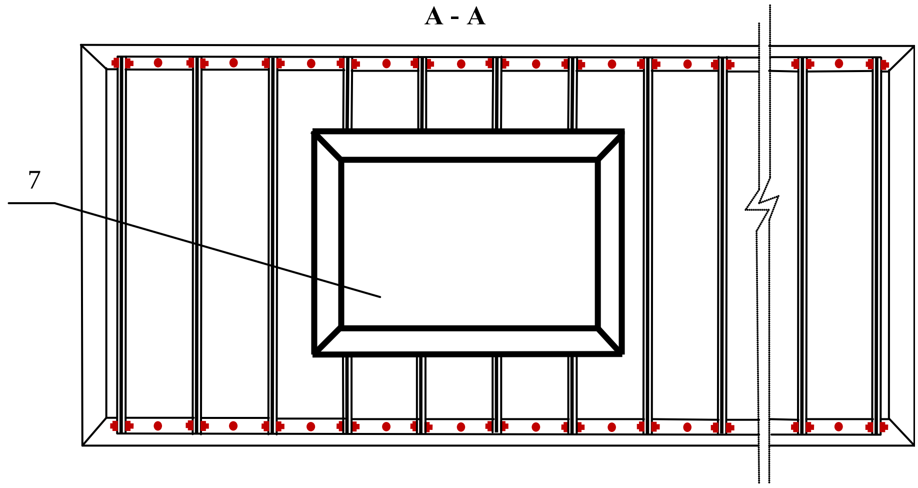
C_M , C_N - Clutch material model and the real nature of soil.

a)



b)

A - A



a - side view, b - top view with model of ground dam

Fig 1 Stand for research deformations model dirt dam

When modeling of cohesive soils according to equivalent material, to establish the scale model, you must define the following physical characteristics of the sand mixture: a, φ, E, γ. Below are examples of data on the selection of the material equivalent to the dam of the loam with physical- mechanical characteristics shown in Table 1. Scale Models - 1/40 ÷ 1/4. Subgrade material model takes a mixture consisting of 97% fine quartz sand and 3% by weight of the spindle oil having a grip that allows modeling of cohesive soils. The results of the selection of the model parameters shown in Table 2.

Table 1

Physical and mechanical parameters of the nature dam

Type of soil	Specific gravity, γ (kN/m^3)	Clutch C, (kPa)	Angle of internal friction, (deg)	Modulus of deformation, E (MPa)	Poisson's ratio ν
Loam	20,5	40	22	20	0,3

Table 2

Physical and mechanical parameters of the model dam

Type of soil	Specific gravity, γ (kN/m^3)	Clutch C, (kPa)	Angle of internal friction, (deg)	Modulus of deformation, E (MPa)	Poisson's ratio ν
Sand - 97% + 3% - spindle oil	17,0	0,90	39	0,27	0,25

Preparing a dam. Preparing a dam without reinforcement is accomplished by layering (5 cm to 8 layers) with tamper roller (Fig. 2).

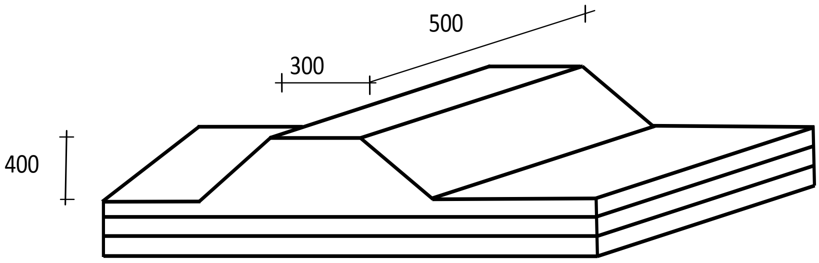
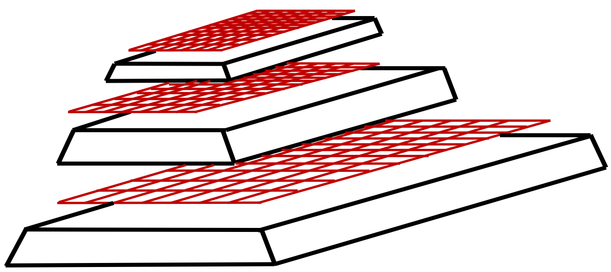
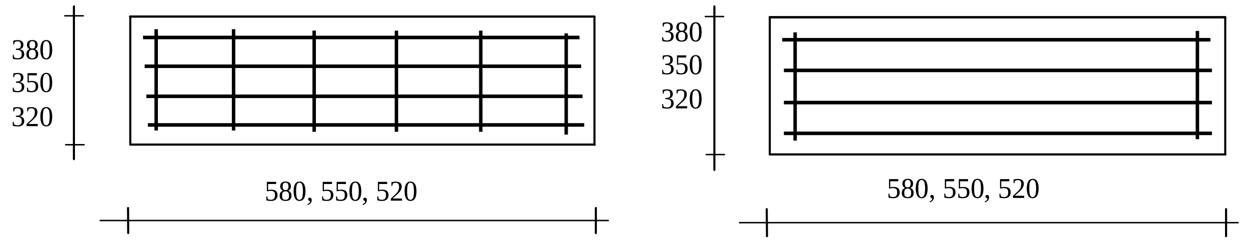


Fig. 2-A general model of the dam

Circuit training model mound of soil layers with reinforcement is shown in Figure 3.



a) b)



a - the general scheme of reinforcement, b - options reinforced grids

Fig. 3 - Schematic model of the dam reinforcement

Application schema model loads on the dam. Basis of physical modeling of dam consists of the following series of experiments:

- Carrying out the model of the dam under various conditions of horizontal expansion and contraction without foundation reinforcement embankment dam model when laying in the longitudinal direction of the stand.

- Carrying out the model of the dam under various conditions of horizontal tension and compression reinforcement base to the mound in the longitudinal direction of the stand.

In experiments with reinforced and unreinforced are used the following series of experiments:

a) Test model of the dam without reinforcement on the ground, pre- deformed in a horizontal direction to a value of $\varepsilon = (3, 6, 9, 12, 15, 20)\ 10^{-3}$. (Fig. 4).

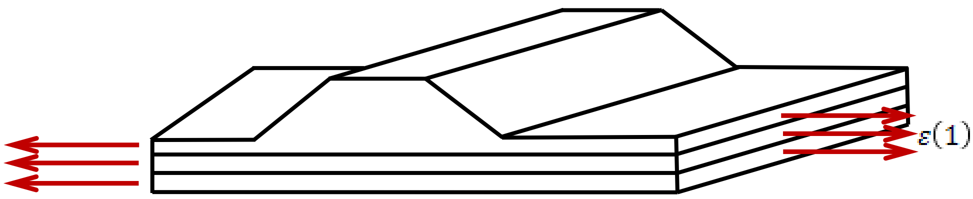


Fig. 4

b) The test is based on the model of the dam, which has undergone a pre-horizontal tensile strain ε = (3, 6, 9, 12, 15, 20) 10-3 and returned to its original state ε = (0). (Fig. 5)

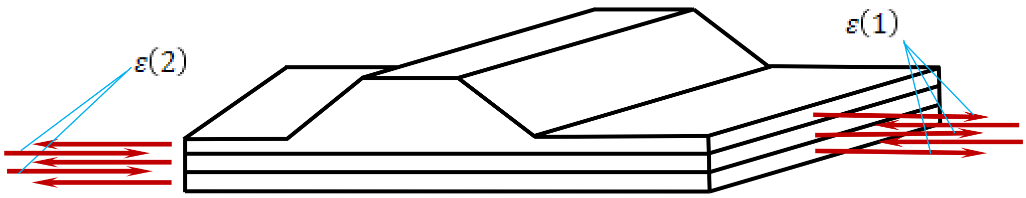


Fig. 5

b) The test model of the dam based on the cycles of deformation at different soil strata (Figure 6):

1) $\varepsilon = 0, \varepsilon = 6 \times [10]\ \uparrow(-3);\ \varepsilon = 0, \varepsilon = 6 \times [10]\ \uparrow(-3), \varepsilon = 0;$

2) $\varepsilon = 0, \varepsilon = 3 \times [10]\ \uparrow(-3);\ \varepsilon = 0, \varepsilon = 6 \times [10]\ \uparrow(-3), \varepsilon = 0;\ \varepsilon = 9 \times [10]\ \uparrow(-3), \varepsilon = 0;$

This scheme mimics the effect of undermining repeated on the bearing capacity and ductility of the sole base model dam.

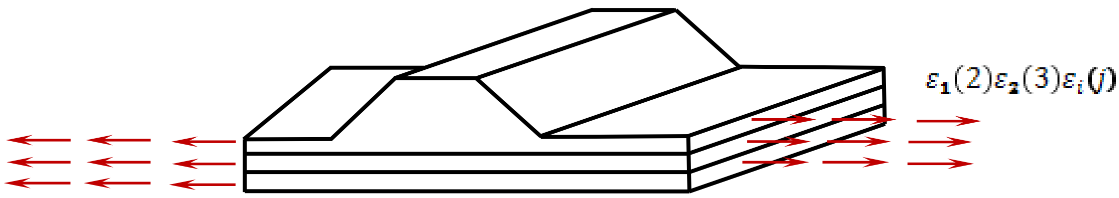


Fig. 6

Numerical evaluation of the impact of part-time work on the territory of the stress-strain state of the dam. Consider the results of the performed numerical calculations of the stress-strain state of the dam height of 12 m using finite element method (FEM). The calculations are performed on the program GEOMECHANICS [3] c using elastic-perfectly-plastic model of soil deformation under the scheme shown in Fig. 4. Data on the physical and mechanical properties of the soil are given in Table 1.

Figure 7 shows the contours of vertical displacements of the points of the dam, and Figure 8 - zone limit state in a mound of soil at various circuits horizontal deformation of foundation: a - in the absence of pre-deformation, b - under the influence of pre-strain $\varepsilon = 6\ 10^{-3}$.

a) b)

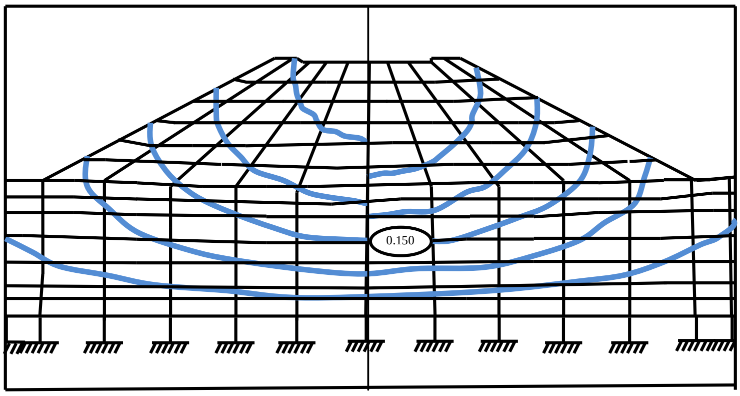


Fig. 7 - Contours of vertical displacements of the dam

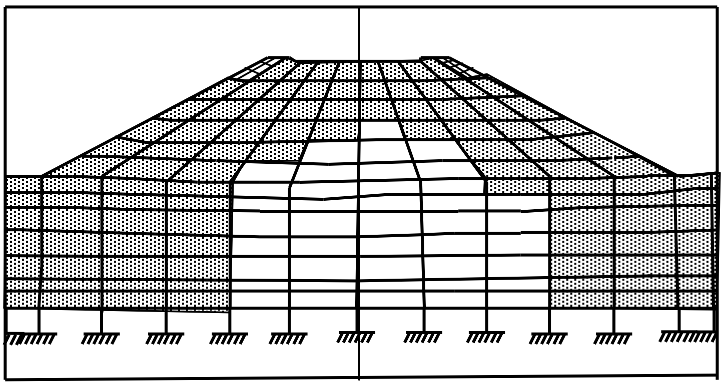


Fig. 8 - Develop zones limiting condition of soils in embankment

Their analysis shows that the pre-deformation of the base of the dam generated when undermined territory, has a significant impact on its stress-strain state.

Findings

1. Designed and manufactured construction laboratory bench allows for physical modeling of dams on undermined territories with different variants of deformation of their bases.

2. According to the results of numerical calculations confirmed the need for comprehensive studies of dams on undermined territories using the methods of the physical and mathematical modeling.

References

1. Жусупбеков А.Ж. Строительные свойства оснований фундаментов сооружений на подрабатываемых территориях - Алматы: Гылым, 1994. – 162 с.

2. Моделирование проявлений горного давления / Г.Н. Кузнецов, М.Н. Будько, Ю.И. Васильев и др. – Л.:Недра, 1968. –280 с.

3. Фадеев А.Б. Метод конечных элементов в геомеханике. – М.: Недра, 1987. – 221 с.

Статья отправлена: 06.12.2013г.

J11404-003

Logachev I.N., Logachev K.I., Seminenko A.S.

BASIC EQUATIONS OF PARTICLE DYNAMICS IN SILO TYPE HOPPERS DURING PNEUMATIC CHARGING

Belgorod State Technological University named after V.G. Shukhov,
Russia, Belgorod, Kostyukov str., 46. 308012

Summary. The study deals with aerodynamic parameters of the hopper charging unit, determines the forces acting upon a particle and establishes the equation systems for the velocity field of air stream jets.

The research was supported by the Strategic Development Program Belgorod State Technological University named after V.G. Shukhov for the period 2012 – 2016.

Key words: hopper aspiration, charging of silo type hoppers, particle dynamics, aerodynamics, dedusting ventilation.

Introduction. The process of cement charging in the hopper and the regularities of their allocation over its cross section are to a large extent determined on the basis of paths of individual particles. In this case, it depends on their grain size, on the aerodynamic field of air velocity within the hopper as well as on initial discharge conditions of the two-component mix ‘solid particles and air’ from discharge chutes of the pneumatic transportation system.

Typical discharge features of this mix are considerable component velocity (15-20 m/sec) and stream type flowing of the carrier medium, i.e., of the air. Considering the large size of cement silos (diameter of up to 8-12 m), let us identify such flow with free isothermal streams.

1. Task setting. Basic equations. Any falling particle is subjected to two active external forces [1]: gravity forces and aerodynamic forces:

$$m\frac{d\vec{\vartheta}}{dt}=\vec{P}+\vec{A}, \tag{1}$$

where $\vec{\vartheta}$ is the particle velocity vector (m/sec), $m=\frac{\pi d_{eq}^3}{6}\rho_p$ is the particle weight (kg), $d_э$ is the equivalent diameter of a particle (m), and ρ_p is the particle density (kg/m^3).

The gravity force is determined by the following vector:

$$\vec{P}=m\vec{g}, \tag{2}$$

where $\vec{g}$ is the acceleration vector of the gravity force (m/sec); it is assumed to be $g=9.81$ m/sec for the calculation purposes.

The aerodynamic force depends on particle shape and size, and it's a function of relative velocity of the carrier medium:

$$\vec{R}=\psi F_M\frac{\left|\vec{u}-\vec{\vartheta}\right|\left(\vec{u}-\vec{\vartheta}\right)}{2}\rho, \tag{3}$$

where $\vec{u}$ is the velocity vector of the carrier medium (air) (m/sec), ρ is the air density (kg/m^3), F_M is the midsection area (m^2), ψ is the particle drag coefficient depending on its shape and on the Reynolds number.

As regards particles produced by means of crushing (the so-called sharp-grain particles), the following two-member Oseen type formula is commonly applied (for example, for calculation of aspiration systems) [2]:

$$\psi=\frac{24}{\mathrm{Re}}+\psi_0, \tag{4}$$

where ψ_0 is the drag coefficient in the area of self-similarity (ψ_0 = 1.8 for the sharp-grain particles), and Re is the Reynolds number, which in this case is equal to:

$$\mathrm{Re}=\frac{\left|\vec{u}-\vec{\vartheta}\right|\rho d_{eq}}{\mu}, \tag{5}$$

where μ is the dynamic viscosity ratio of the air (Pa sec).

For fine cement particles (d_{eq} < 15 μm), and with $\mathrm{Re} \le 1$, the drag coefficient will be:

$$\psi = \frac{24}{\mathrm{Re}}\ , \tag{6}$$

And the aerodynamic force features a linear dependence on the relative velocity:

$$\vec{R} = 3\pi\mu\, d_{eq}\left(\vec{u} - \vec{\vartheta}\right), \tag{7}$$

i.e., it is determined by the Stokes formula, which makes it easier to integrate the dynamics equations. For example, the equation (1) can be presented as follows for stationary air ($\vec{u} = 0$):

$$\int_{\vec{\vartheta}_0}^{\vec{\vartheta}} \frac{d\vec{\vartheta}}{\vec{g} - k\vec{\vartheta}} = \int_0^t \frac{dt}{m},$$

Hence the formula for changing of the velocity vector of the falling particle during the t time (sec):

$$\vec{\vartheta} = \vec{\vartheta}_0\, e^{-kt} + \frac{\vec{g}}{k}(1 - e^{-kt}), \tag{8}$$

where

$$k = \frac{3\pi\mu\, d_{eq}}{m}, \tag{9}$$

$\vec{\vartheta}_0$ is the particle velocity vector at the initial moment of time.

Particle paths should be projected upon coordinate axes of the selected coordinate system. To this end, we will use cylindrical coordinate axes x, y, φ; note that polar coordinates of the y, φ lie in the horizontal plane, which is perpendicular to the downward looking vertical axis 0x. In this case, projection of the vector equation (1) for fine particles will be as follows:

$$\frac{d\vartheta_y}{dt} = 3\pi\mu\, d_{eq}\left(u_y - \vartheta_y\right), \tag{10}$$

$$\frac{d\vartheta_\varphi}{dt} = 3\pi\mu\, d_{eq}\left(u_\varphi - \vartheta_\varphi\right), \tag{11}$$

$$\frac{d\vartheta_x}{dt} = mg + 3\pi\mu\, d_{eq}\left(u_x - \vartheta_x\right), \tag{12}$$

or, taking into consideration the stationary character of particle falling:

$$\frac{d\vartheta_y}{dt}=\frac{d^2y}{dt^2}-y(\frac{d\varphi}{dt})^2; \tag{13}$$

$$\frac{d\vartheta_\varphi}{dt}=y\frac{d^2\varphi}{dt^2}+2\frac{dy}{dt}\cdot\frac{d\varphi}{dt}; \tag{14}$$

$$\frac{d\vartheta_x}{dt}=\frac{d^2x}{dt^2}; \tag{15}$$

$$\vartheta_y=\frac{dy}{dt}; \tag{16}$$

$$\vartheta_\varphi=y\frac{d\varphi}{dt}; \tag{17}$$

$$\vartheta_x=\frac{dx}{dt}, \tag{18}$$

we will have the following system of three second order differential equations:

$$m\frac{d^2y}{dt^2}=m\,y\,\frac{d\varphi}{dt}+3\pi\mu d_{eq}\left(u_y-\frac{dy}{dt}\right), \tag{19}$$

$$m\,y\frac{d^2\varphi}{dt^2}=-2m\frac{dy}{dt}+3\pi\mu d_{eq}\left(u_\varphi-y\frac{d\varphi}{dt}\right), \tag{20}$$

$$m\frac{d^2x}{dt^2}=mg+3\pi\mu d_{eq}\left(u_x-\frac{dx}{dt}\right). \tag{21}$$

Here, ϑ_y, ϑ_φ and ϑ_x are projections of the particle velocity vector upon the 0y axis (radial constituent of the velocity), upon the perpendicular of the 0y axis (circumferential velocity) and upon the vertical 0x axis (particle travel speed), respectively; u_y, u_φ and u_x are the corresponding projections of the air velocity vector. In the right-hand part of the equation system (19) - (21), the first two members represent the centrifugal force, the Coriolis force and the gravity force.

Due to the non-linear character, the equation system (19) - (21) mostly cannot be solved in quadratures, and it can only be studied via numerical methods [3]. In order to reduce the number of variables, the non-dimensional form of dynamics equations (first order differential equations) is most frequently used. In our case (given the cylindrical coordinate system and the stationary dynamics of the air and its particles), the system of the second order equations (19) - (21) can be presented as follows:

$$\frac{dx}{dt} = \vartheta_x, \tag{22}$$

$$\frac{dy}{dt} = \vartheta_y, \tag{23}$$

$$\frac{d\varphi}{dt} = \frac{\vartheta_\varphi}{y} = w_\varphi, \tag{24}$$

$$\frac{d\vartheta_x}{dt} = g + k(u_x - \vartheta_x); \tag{25}$$

$$\frac{d\vartheta_y}{dt} = yw_\varphi^2 + k(u_y - \vartheta_y); \tag{26}$$

$$\frac{dw_y}{dt} = -2\vartheta_y \frac{w_\varphi}{y} + \frac{k}{y}(u_\varphi - y\,w_\varphi); \tag{27}$$

Sometimes the canonic form is used for writing the dynamics equation system:

$$\dot{x}_1 = f_1(x_1, x_2, x_3, \dots x_n, t). \tag{28}$$

Let us use the canonic form for the equation system (22) – (27) expressed in non-dimensional values. To do that, let us accept the following arbitrary system of basic parameters: reference length – l_∞, velocity – u_∞, time – $\tau_\infty = l_\infty / u_\infty$, and let us introduce the system of non-dimensional values:

$$x_1 = \frac{x}{l_\infty}; \;\; x_2 = \frac{y}{l_\infty}; \;\; x_3 = \varphi;. \tag{29}$$

$$x_4 = \frac{\vartheta_x}{u_\infty}; \;\; x_5 = \frac{\vartheta_y}{u_\infty}; \;\; x_6 = \frac{d\varphi}{dt}\tau_\infty; \;\; \tau = \frac{t}{l_\infty}u_\infty. \tag{30}$$

Hence we obtain:

$$\dot{x}_1 = x_4; \;\; \dot{x}_2 = x_5; \;\; \dot{x}_3 = x_6; \tag{31}$$

$$\dot{x}_4 = Fr + \frac{1}{St}\left(\frac{u_x}{u_\infty} - x_4\right); \tag{32}$$

$$\dot{x}_5 = x_2\ x_6^2 + \frac{1}{St}\left(\frac{u_y}{u_\infty} - x_5\right); \tag{33}$$

$$\dot{x}_6 = \frac{1}{x_2}\left(-2\,x_2\,x_6 + \frac{1}{St}\left(\frac{u_\varphi}{u_\infty} - x_2\ x_6\right)\right); \tag{34}$$

where Fr is the Froude number taking into consideration the gravity forces:

$$Fr = \frac{g\,l_\infty}{u_\infty}; \tag{35}$$

St is the Stokes number taking into consideration the aerodynamic forces:

$$St = \frac{u_\infty}{k\ l_\infty} = \frac{d_{eq}^2\ \rho_p\ u_\infty}{18\ \mu\ l_\infty}; \tag{36}$$

$\frac{u_x}{u_\infty}$, $\frac{u_y}{u_\infty}$, $\frac{u_\varphi}{u_\infty}$ are non-dimensional constituents of the stream jet, which should be set by means of functions of non-dimensional coordinates $x_1,\ x_2,\ x_3$.

2. Determination of initial conditions. As a rule, when formulating initial conditions of the parameters for description of the velocity field of air stream jets, the size of an outlet (diameter – in case of a circular outlet, or slot height b_0 – in case of a slot type outlet, for flat and radial jets) is used as the reference length [4], and the air velocity with mean air flow rate at the outlet (u_0) is used as the reference velocity. Naturally, in this case, reference time will be as follows:

$$\tau_\infty = \frac{d_0}{u_0};\ \text{ or }\ \tau_\infty = \frac{b_0}{u_0}. \tag{37}$$

In order to analyze particle paths throughout the hopper (with the purpose of finding an efficient layout of material depositing), it would be reasonable to use either the hopper diameter D (m) or its depth H (m) as the reference length. In this case, the reference time will be as follows:

$$\tau_\infty = \frac{D}{u_0};\ \text{ or }\ \tau_\infty = \frac{H}{u_0}, \tag{38}$$

It has a certain physical sense, namely, in the last case, it specifies the order of time for particle falling all over the hopper depth.

Let us assume following as the initial conditions (with $\tau = \dfrac{t}{\tau_\infty} = 0$):

for initial points of the paths:

$$x_1(0) = \frac{x}{l_\infty} = 0; \tag{39}$$

$$x_2(0) = \frac{y_0}{l_\infty} = a \neq 0; \tag{40}$$

for example, $0 < y \leq d_0 / 2$ for a circular chute;

$$x_3(0) = \varphi = 0; \tag{41}$$

for final points of the paths (maximum values):

$$x_1(\tau_\kappa) = \frac{H}{l_\infty}; \quad \text{or} \quad x_1(\tau_\kappa) = \frac{D}{l_\infty}; \tag{42}$$

$$x_2(\tau_\kappa) \leq \frac{D}{2\, l_\infty}; \tag{43}$$

for constituents of initial particle velocities:

$$x_4(0) = \frac{\vartheta_x(0)}{u_0} \geq 1; \tag{44}$$

$$x_5(0) = \frac{\vartheta_y(0)}{u_0} = 0; \tag{45}$$

$$x_2(0) \cdot x_6(0) \geq \frac{u_\varphi}{u_0}. \tag{46}$$

These conditions will be adjusted taking into consideration the character of the velocity field and the hopper charging schemes.

Conclusion. Therefore, using the equation systems (22)-(27) and (31)-(34), it is possible to determine the velocity field in the charging unit of silo type hoppers as well as movement paths of solid particles, which is necessary for designing of efficient dedusting systems.

References:

1. Логачев И.Н. Инерционное сепарирование в узлах загрузки бункеров / Логачев И.Н.Феоктистов А.Ю., Семиненко А.С. Гольцов А.Б. Киреев В.М. //

Современные проблемы технического естественно-научного и гуманитарного знания: Сборник докладов Всероссийской научно-практической конференции. – Губкин: «Интерфейс», 2007 г. с. 110-113.

2. Аспирация и обеспыливание воздуха при производстве порошков. / Нейков О.Д., Логачев И.Н. // М.: Металлургия, 1981, 192 с.

3. Averkova O.A. Modeling of gas separated flows at inlet of suction channels on the basis of stationary discrete vortices / Averkova O.A., Logachev I.N., Logachev K.I., Logachev A.K. // ECCOMAS 2012 - European Congress on Computational Methods in Applied Sciences and Engineering, e-Book Full Papers 2012. С. 812-831.

4. Семиненко А.С. Учет влияния градиента давления в интегральной модели описания присоединенных струй / Семиненко А.С., Малахов Д.Ю. Попов Е.Н. Алифанова А.И. // Современные наукоемкие технологии. 2013. № 8-1. С. 42-43.

J11404-004

Polovtsev I.N.

ON FOUNDATION OF THE UNIVERSITY CAMPUS IN PETERHOF

Saint-Petersburg State University

Russia, 199034 Saint-Petersburg, University emb., 7/9

Abstract. The article deals with the architectural and planning decisions are taken at the Foundation of a new campus of the University of Leningrad (now St. Petersburg) University in the city of Petrodvorets at the end of the last century.

Key words: Land development, Plan, Campus, Leningrad University, Saint-Petersburg University.

Leningrad State University after A.A.Zhdanov, now Saint-Petersburg State University, has always been, alongside Lomonosov Moscow State University, the leading institution of higher education in the country. The university produced the most highly qualified professionals in many spheres of sciences and arts. Its downtown location had made it difficult for the university to grow. Due to there being no territories available for planned development, the university had to adapt buildings across the city to accommodate new students. This lowered the effectiveness of training, made it more difficult for the faculty to share their experience, significantly increased administrative charges and required time to move between buildings.

In the 1950s the University once again faced the problem of further growth. No free territories were found downtown Leningrad. Therefore a decision was adopted to set up the university campus in a city suburb. The experience of leading foreign universities (Oxford and Cambridge) and the experience of setting up the Novosibirsk Academic City testified to practicality of this approach. A decision was made to set up the campus between two palace and park ensembles on the coast of the Gulf of Finland - Petrodvorets (Peterhof) and Lomonosov (Oranienbaum). The decision to move Leningrad State University from its downtown location was adopted at the top level: in July 1966 a special decision on this issue was adopted by the Politburo. In October of the same year the USSR Government commissioned the project in Petrodvorets [1].

The project was prepared by a team of architects overseen by Igor Ivanovich Fomin, D.F.A. (Arch.), Member of the Academy of Architecture and Construction of the USSR. Within just one year his Workshop No. 10 in LenProject Institute prepared a project of the future campus in the western section of Petrodvorets [2].

The total area of the site was 15,55 square kilometers. The campus was supposed to include academic and residential buildings for students, faculty and staff. Some 17,700 in-residence students were expected to move to the new campus, including 2,000 graduate students and 2,700 in-service training students. The total number of faculty and staff was expected to reach the figure of 12,000 [3, 4].

The entire territory of the future campus was subdivided into six zones: academic zone, athletic zone, student dormitories, faculty and staff apartments, recreation zone and administrative zone. Academician Fomin and his team suggested a layout scheme around two intersecting thoroughfares: Universitetskiy Prospekt

(University Avenue) lay across the campus from east to west. Morskoy Prospekt (Marine Avenue) ran perpendicular to the latter, from the student dorms on the south end to the Gulf of Finland coast on the north end. At the intersection stood Ploschad Nauki (Science Square). Separate buildings were supposed to be built for each of the Natural Science faculties (faculties of physics, mechanics and mathematics, chemistry, biology and soil science, geology and geography). All humanities faculties were supposed to be located in one building. The Rector's Office, the library building, 4 dining centers, the Military Education Center, the In-Service Training Building and the Astronomic Observatory buildings were planned as separate buildings. The total volume of all academic and research buildings was expected to be around 1,812,000 cubic meters. The academic and research area was supposed to span 127 hectares. Botanical Gardens were supposed to span the territory of 56 hectares.

An athletic zone was designed to span 64 hectares, with open-air and roofed athletic facilities, swimming pools and a stadium seating 25,000. A yacht club was set up on the coast of the Gulf of Finland.

Student dorms with the capacity of 17,700 students occupied the area of 54 hectares. The total area of dormitories was 94,000 square meters. Family housing and faculty and staff apartments were located in the eastern section of the site. The railroad line between Leningrad and Oranienbaum with Staryi Petergof Station divided the grounds into north and south sections (37 and 180 hectares respectively). Standard residential buildings were to be built in the northern section, and individual architectural projects were to be used in the south section. For the south section I.I. Fomin offered a new type of sporadic buildings layout, with varying numbers of floors. The total area of all apartment buildings was supposed to reach 447,000 square meters. The average residential density would have been 2,800 square meters per hectare (for 5-storied buildings). The residential area would cover 17% of the campus grounds.

A total of 27 hectares of the land was allocated to cultural and entertainment buildings and service facilities, so that there were 12 square meters of district and city level public building area per resident. Transport accessibility was also an important factor in the project. Some of the transport routes were intended to service the campus, other transport routes were to pass through the campus: a high speed highway was designed to connect Lomonosov and Petrodvorets that would run across campus. The streets occupied 11.2% of the territory. There was a total of 85.7 square meters of streets and squares planned per each resident.

In August 1969 the layout project was approved by the Executive Committee of the Leningrad City Soviet of People's Deputies. The project could finally be implemented.

The new campus of Leningrad State University in Petrodvorets was named the Petrodvorets Research and Education Center (PREC). The campus was further designed by Workshop No. 10 of LenProject. The technical project of the first stage of construction was approved in 1972. The first projects of the second stage were approved by the same Institute in 1984.

The first academic building completed in 1971 on the grounds of the PREC was the building of the Faculty of Physics (designed by Giprovuz Institute, total area of 37,100 square meters). The next building was the building of the Physics Research and Development Institute (48,500 square meters, 1977). In 1979 the building of the Faculty of Mathematics and Mechanics was completed (43,900 square meters). In 1988 - the building of the Faculty of Chemistry (47,500 square meters). The project to build the Petrodvorets Campus was so important that a special Directorate for Construction of Leningrad University Campus in Petrodvorets was organized [5]. The construction of the campus, faculty apartments and service buildings ran concurrently. Due to the crisis that followed after the collapse of the Soviet Union in the 1990s the campus project was never completed. The construction of Geology and Geography buildings was suspended for several years. A part of that building (15,700 square meters in area) now houses the Department of Applied Mathematics and Control Processes.

Although the campus project was never completed, it has served a model for other university campus facilities of the Soviet era. After academic and research activities were relocated from downtown Leningrad to Petrodvorets, the University's research results improved dramatically. Additionally, a new campus in Petrodvorets (now Peterhof) helped jumpstart development of all adjacent territories.

Today St. Petersburg State University uses a total of 727,800 square meters of buildings (not taking into account suburban bases and new construction projects). Of those, 409,900 square meters of facilities are located on the grounds of the Petrodvorets campus (including 119,500 square meters of dorms, and 234,100 square meters of academic and research buildings). Such extensive instructional and research facilities could not have been built downtown.

Literature:

1. Rasporyazhenie Soveta Ministrov RSFSR ot 17.10.1967 №2741-r [Order of Counscil of Ministres of RSFSR of 17.10.1967 No.2741-r]. Arkhiv Upravleniya kapital’nogo stroitel’stva I rekonstrukzii Sankt-Peterburgskogo gosudarstvennogo universiteta . F. 3. Op.1, D.1.

2. Polovtsev I.N. Universitetskij kompleks v Petrodvortse – detishe akademika arkhitektury Igorya Fomina [University campus in Petrodvorets, the brainchild of the academician of Arts Igor Fomin] // Vestnik grazhdanskih inzhenerov [Bulletin of Civil Engineers], 2013, No.5(40), pp.52-57.

3. Tsentral’nyy gosudarstvennyy istoricheskiy arkhiv Sankt-Peterburga [Centeral State Archive of History of Saint-Petersburg]. F.R-7384 Gorsovet. Op.43, D.432.

4. Polovtsev I.N. O territorialnom planirovanii zony stroitelstva Leningradskogo universiteta v Petrodvortse v 60-h godah XX veka [On Construction Project Layout of Petrodvorets Campus of Leningrad State University in the 1960s] // Naukovedenie [Science of science], 2013, No.5(18), p.83. Id: 46TBH513.

5. Polovtsev I.N. K istorii direkzii stroite’stva zdanij dlya Leningradskogo universiteta v Petrodvortse [To history of management of construction of buildings for the Leningrad university in Petrodvorets] // Al’manakh sovremennoy nauki I obrazovaniya [Almanac of Modern Science and Education], 2013, No.6, pp.137-141.

Статья отправлена: 05.03.2014г.

J11404-005

Chernyshev A.N., Efimova T.V.

RESEARCH OF DRYING PROCESS OF CHERRY AND SWEET CHERRY WOOD WITHOUT ARTIFICIAL HUMIDIFICATION IN CONVECTIVE DRYING CHAMBERS OF PERIODIC ACTION

FSBEI HPE «Voronezh State Forestry Engineering Academy»,

394087, 8, Timiryazeva str, Voronezh

Abstract. The paper discusses the features of the process carrying out and drying modes without artificial humidification of uncut sawn timber of cherry and sweet cherry in convective drying chambers without artificial humidification.

Keywords: cherry, sweet cherry, drying, density, mode.

With the belonging to market values in Russia demand for high-quality items of interiors appeared, made by individual projects in a single copy of fine wood and exotic species. These include cherry (botanical name - *Prunus avium*, family *Rosaceae*), which is grown practically in all countries of temperate zone of Northern Hemisphere. In Russia, cherry can be found on entire European part (in the north - to Vologda and Kirov), as well as in the south of Western Siberia , it is especially prevalent in the southern regions, the Caucasus, the Stavropol Territory, in the southern regions of Central Russia - Belgorod, Orel , Voronezh. There is one kind, which is worth mentioning separately. This is sweet cherry (*Cerasus avium*). It is not only an ancestor of almost all cultivated fruit varieties of cherries, but it is also very widely used in culture as a fruit tree. Sweet cherry is larger than all other species of the genus *Cerasus* - its height is 35 meters with a trunk diameter of 50-60 cm, so it is of commercial importance in the technology of wood processing. It grows fast, it is durable: age of life - more than 100 years.

At the Department of Mechanical Wood Technology research of physical and mechanical properties of soft hardwoods was carried out for the past 4 years to provide companies in the region with scientific and technical, design, engineering and technological information on the problem of the mechanical processing and drying of cherry and sweet cherry wood. To do this, net blanks were cut out for samples of the radial and tangential cutting with dimensions 30×20×20 mm in an amount necessary and sufficient to conduct comprehensive research. Both appearance, texture, and such indicators as the number of growth rings per unit area, roughness, hardness, moisture, shrinkage, density, friability, and the modulus of elasticity and tensile strength were evaluated. Unedged boards supplied from the North Caucasus once every two months, with thickness of 50 mm (70%) and 32mm (30%), length of 3 m and a width of 200 to 600 mm were used as a starting material. The volume of one batch was about 30 m^3. Boards without drawbacks and were chosen from the batch and they were cut out into blanks for samples. Moisture and density in a state of fresh fell were determined immediately. Then, to achieve an intermediate or final experimental humidity samples were kept in exiccator over sulfuric acid solution of appropriate concentration. Thereafter, the rest experiments were carried out for obtaining other indicators.

Cherry is heartwood. Heart colour is from reddish brown to intense red. Sapwood of cherry wood is narrow, pinkish or yellowish. Mature wood of cherry is pink-brownish, sometimes grayish-pink. Cherry wood structure is homogeneous flat fiber with visible annual layers on all cuts. Radial cut reveals streaking. The fiber organization is mainly direct. Cherry is highly flat density wood. The number of annual rings on 1 cm of cross cut for sweet cherry that grows in the Caucasus, on the average, is 2.8. Microroughnesses remaining after surface treatment of cherry wood make up R_m 32-40 microns, so finishing products made of it is able to give glossy shine of the surface. For resistance to decay and other biological attacks sweet cherry is referred to medium-resistant woods. Cherry (sweet cherry) wood is viscous, on mechanical properties, in particular hardness (Brinell 3.0-3.3) is significantly softer than oak and beech wood, it lends itself well to all kinds of processing, it is easily processed by the cutting tool, sanded, polished, toned and finished [1]. Optimum cutting angle is 200. Green wood of cherry (sweet cherry) has a moisture content of about 65%. Cherry belongs to low shrinkable woods. Averaged values of the coefficient of swelling / shrinkage: radial Kr = 0,14; tangential Kt = 0,27; volume Kv

= 0,43; wood density under normalized humidity W=12% ρ_{12} =570-630 kg/m^3. Indicators of elasticity and strength have the form of Newton's second order polynomials:

- tensile strength of cherry wood, MPa:

$$\sigma = 5{,}392 + 0{,}0145t - 0{,}2316W - 0{,}0007t^2 + 0{,}004W^2 - 0{,}00072tW; \tag{1}$$

- cherry wood modulus of elasticity, MPa:

$$E = 587{,}05 - 8{,}589t - 12{,}774W + 0{,}017t^2 + 0{,}0008W^2 - 0{,}181tW. \tag{2}$$

Cherry wood is very decorative. Cherry products are well suited for rooms with northern location and lighting. Under the influence of sunlight and as a result of finishing cherries wood gets nice warm golden reddish-brown colour, resembling the color of red wood (mahogany). Due to the low hardness and wear resistance (abrasion) - 0.24 mm tangential - it is undesirable to apply for parquet and stairs.

However, a major problem in mechanical technology of cherry is chamber drying, and without artificial humidification of medium. In view of the fact that amounts of wood processing are insignificant, use of industrial superheated steam generators is not economically feasible. In connection with the designated circumstances, it was decided not to adhere to the traditional drying technology [2], since the use of this technique in full without steam for drying is not possible due to lack of it.

In the study of complex processes where direct experiments are complex, costly or even can not be held, it is advisable to use the method of mathematical modeling. The mathematical model consists of a system of equations describing each of these phenomena, and allows calculation of the basic parameters of the process throughout its duration, namely: the distribution of temperature and humidity on the volume of the material, the parameters characterizing the stiffness, stability and strength of the wood, the magnitude of the internal stresses , drying duration.

In particular, we have obtained the following relationships for the first two figures:

$$t_n = t_0 + t_c(1 - 0{,}488\exp(-Pd^{/}Fo^{/}) - 0{,}232\exp(-z_i\tau)), \tag{3}$$

$$t_{ц} = t_0 + t_c(1 - 0{,}688\exp(-Pd^{/}Fo^{/}) - 0{,}112\exp(-z_i\tau)), \qquad (4)$$

$$tc = 85{,}12(1 - 0{,}56\exp(-0{,}224\tau) - 0{,}448\exp(-0{,}028\tau) - 0{,}112\exp(-0{,}0325\tau), \qquad (5)$$

- stage of irregular mode (period of constant drying rate)

$$W(x,y,z,\tau) = W_H - ((W_H - W_P)(1{,}5\frac{Bi^2}{88}\exp(-3{,}51(\frac{1-\cos\frac{z}{h}\cos\frac{y}{b}\cos\frac{x}{l}}{2\sqrt{F_o}})) \times$$
$$\times(2{,}162\sqrt{\frac{z}{h}\frac{y}{b}\frac{x}{l}F_o} + F_o\sqrt{\frac{z}{h}\frac{y}{b}\frac{x}{l}}(0{,}125\frac{h}{z}\frac{b}{y}\frac{l}{x} + \frac{4}{7} - \frac{Bi^2}{88}))), \qquad (6)$$

- stage of regular mode (period of decreasing drying rate)

$$W(x,y,z,\tau) = W_{ц}(\tau) - (\frac{z}{h}\frac{y}{b}\frac{x}{l})^2(W_{ц}(\tau) - W_n(\tau)), \qquad (7)$$

$$W_{ц}(\tau) = (W_H - W_P)\frac{Bi}{Bi - 1/2}(1 - \exp(-F_o(\frac{Bi}{Bi-1/2})^2) \times 2{,}125\exp(-3{,}9(\frac{Bi}{Bi-1/2})\sqrt{Fo}))), \qquad (8)$$

$$W_n(\tau) = (W_H - W_P)(1 - 4{,}05\times10^{-4}F_o Bi\exp(-\frac{1}{4{,}05Fo})), \qquad (9)$$

$$a' = 2{,}631(t_c + 273)^{10}\times10^{-21},$$

where: t_s – temperature on the material surface, ^{0}C;

t_c - temperature in the centre of material, ^{0}C;

t_m – temperature of the medium, ^{0}C;

W_a – humidity in the center of the assortment, %;

W_s – humidity on the surface of the assortment, %;

W_e – equilibrium moisture of assortment: $W_p = 10{,}6^{\varphi}(0{,}03 - 0{,}00015t)\times100$, %;

$Pd' = \frac{e_T R^2}{a'(t_{c0} - t_0)}$ and $F_O' = \frac{a'\tau}{R^2}$ - heat transfer criteria of Predvoditelev and Fourier characterizing unsteadiness of heat transfer process (e_T – rate of temperature change, specified from technological considerations);

$a^{/}$ - thermal diffusivity, which determines the inertia of the material, i.e. its ability to smooth out the temperature, W × m^2/J.

After the implementation of the model values of transition humidities and other key mode parameters were obtained and then practical industrial dryings of cherry (sweet cherry) were made. After checking on the adequacy so called parabolic modes of chamber drying without artificial humidification were introduced (Table 1). These modes include 4 stages with the initial heating and final wet-heat processing.

Table 1

Modes of low-temperature dryings of cherry lumber in convective chambers without artificial humidification

Average humidity, %	Mode parameters	Thickness, mm			
		Soft modes (S)		Regular modes (R)	
		32	50	32	50
>50	$t, {}^0C$	70	56	74	62
	$\Delta t, {}^0C$	5	3	6	4
	φ	0,79	0,82	0,76	0,82
50-35	$t, {}^0C$	56	42	62	55
	$\Delta t, {}^0C$	3	2	4	5
	φ	0,84	0,89	0,82	0,76
35-25	$t, {}^0C$	68	66	75	72
	$\Delta t, {}^0C$	8	7	10	10
	φ	0,68	0,71	0,64	0,62
<25	$t, {}^0C$	77	70	88	77
	$\Delta t, {}^0C$	22	19	26	22
	φ	0,34	0,37	0,31	0,34

Totally from July 2008 to the present time, 28 dryings of unedged cherry timber were made in 2 stacked dryer by soft modes for furniture and door leaves production and 18 dryings by normal modes in 1-stack chamber for producing door frames, cases, floor moldings, eyebrows, cartouches, balusters, cornices, hand railings, panels, etc. On its physical and and mechanical characteristics cherry wood dries well, fast, smooth; it cracks little, but it is inclined to noticeable warping in the transverse plane. Similar studies have been conducted in other research centers, such as Moscow, Kazan and Yekaterinburg, where they were received so-called "oscillating" or "pulse" modes. However, in our opinion, in practice they can not be used due to the fact that: a) they are advisory in nature, b) they can not reasonable, as their stiffness mode is constant throughout the process, and c) they are not applicable for convective chambers due to its considerable inertia.

Similar studies were carried out by us [3] and for other woods and we obtained modes, for example for oak, Siberian elm and pine. As a result of activities we succeeded to reduce the average duration of the process by 30% to get the lumber dried by soft modes, I category of quality, normal mode - II category of quality.

Conclusions:

- drying processes, extending in special devices without artificial humidification need additional studies to optimize the modes that can adequately respond to the stress-strain condition of assortment by adjusting the mode parameters and lengthening or shortening the duration of stages;

- proposed parabolic drying modes without artificial humidification may be an alternative to the traditional modes for drying in steam-air medium.

References:

1. Ugolev B.N. Wood Science with the basics of forest merchandising. - Moscow: Moscow State Forestry University, 2001. - 336 pp.

2. Guiding technical materials on technology of chamber drying of wood. - Arkhangelsk, CSRIMTW, 2000. -143 pp.

3. Pat. RF № 2319915 C1 MKP7 V1/00 F28, 3/04. The method of lumber drying / A.N. Chernyshev, A.A. Filonov, applicant and patentee SEI HPE "VSAFT". Number 20061116335/06; application.12.05.2006 publl. 20.03.2008, Bull. № 30. - 4pp.

Date of sending: 05.12.2013

J11404-006

Chernyshev A.N., Efimova T.V.

PHYSICAL AND MECHANICAL PROPERTIES AND DRYING MODES OF ASH-TREE WOOD WITHOUT ARTIFICIAL MOISTENING IN CONVECTIVE DRYING CHAMBERS OF PERIODIC ACTION

FSBEI HPE «Voronezh State Forestry Engineering Academy»,

394087, 8, Timiryazeva str, Voronezh

Abstract. In work features of carrying out process and drying modes without artificial moistening of not cut timber of an ash-tree ordinary in convective drying cameras without artificial moistening for production of furniture and joiner's and construction products of a premium class are considered.

Keywords: ash-tree, drying, density, mode.

In the woodworking industry ash-tree wood unfairly is in a shadow magnificent in every respect oak wood. Ash-tree the modest neighbor of an oak who for some reason didn't become such well-known though deserves all praises. Therefore ash-tree occupied the deserved niche as from producers of production from its wood, and consumers. Ash-tree (lat. Fraxinus) - a sort of wood plants from olives's (Oleaceae) family, a big deciduous photophilous tree 25-35 m high (separate copies to 60 m) and with a diameter of trunk up to 1,0-1,5 m, with the elongated and ovoid, highly lifted, wide and roundish krone and thick, rare branches. The area of growth of an ash-tree stretches through all Europe, in Russia is widespread in the Volga region, Central Chernozem area, the Tver region, the Far East. In Russia the ashen woods occupy over 700 thousand hectares that makes 0,1% of the total area of the woods of Russia, including about 200 thousand hectares in the European part and 500 thousand. hectare in the east. Stocks of wood of an ash-tree in these plantings are estimated approximately at 120 million m^3 (0,1% of the general stock). In the European Russia the ash-tree ordinary (Fraxinus excelsior) most often meets.

Specialists of Chair of Mechanical Wood Technology of Voronezh State Forestry Engineering Academy in the contract on the creative commonwealth from one of the developer companies of Voronezh carried out within the last five years of research of physical and mechanical properties of ordinary ash-tree wood of regional growth and made calculations of modes of chamber drying without artificial moistening the environments adapted for drying chambers, established at the enterprise. In total for the specified period the company got 140 m^3 of unedged boards thickness of 32 mm and 50 mm of this breed.

To do this, net blanks were cut out for samples of the radial and tangential cutting with dimensions 30×20×20 mm in an amount necessary and sufficient to conduct comprehensive research. Both appearance, texture, and such indicators [1] as the number of growth rings per unit area, roughness, hardness, moisture, shrinkage, density were evaluated. As an initial material unedged boards delivered as required, thickness of 50 mm (70%) and 32mm (30%), length of 3 m and a width of 200 to 600 mm were used. The volume of one batch was about 10 m^3. Boards without drawbacks and were chosen from the batch and they were cut out into blanks for samples. Moisture and density in a state of fresh fell were determined immediately. Then, to achieve an intermediate or final experimental humidity samples were kept in exiccator over sulfuric acid solution of appropriate concentration

Ordinary ash-tree wood belongs to those breeds which can have a kernel of color different from a sapwood, but often this color is identical. Sapwood and kernel wood happen gray, a whitish, yellowish or reddish shade. Kernel wood of old trees sometimes accepts more dark color, to chocolate-brown that is undesirable because of sharp contrast after finishing. For this breed it is considered the best color and the drawing of kernel wood reminding wood of an olive tree (lat. Olea europaea) with wavy areas of olive-brown and light brown shades seen on a cross-section. Wood porous on year rings, but is much less than time, than at an oak, fiber of early wood clearly more and settle down in accurately distinguishable from ripe wood multirow rings. Has a wide sapwood of white color with the yellowish or pinkish shade, quite often delimited from a light-brown kernel. Year layers are well visible on all cuts, the late zone of a year layer is much wider than the early. On a cross-section early wood consists of one or several rows of the large vessels collected in a ring; late wood dense, contains only small vessels which form small groups in the form of light points or hyphens (at borders of year layers). Core beams are so narrow that with the naked eye are almost imperceptible (wide beams aren't present) and are visible on longitudinal sections as "mirrors". The carving and milled surfaces possess opaque gloss.

Ash-tree wood of the Central Chernozem region, belongs to heavy and firm grades of a tree with good strength characteristics. Its tensile strength and bend exceeds durability of oak wood [1]. It is elastic, the wear resistance and is more viscous, than many domestic breeds of wood. Thus mechanical properties of wood it is better for those, than year rings are wider. Year rings over 1,5 mm wide - a sign of high quality of wood. By results of our researches of prototypes the number of year layers in 1 cm made – 6,17, percent of late wood - 60%.

As the ash-tree hardly gives in to impregnation, it seldom use in the open air. Ash-tree wood differs the hardness, elasticity, durability, smaller fragility, small tendency to cracking, the beautiful texture reminding oak wood and bigger uniformity in comparison with an oak. This wood can be processed as manually, and by means of cars, in the pro-soared state it can be bent as it is good, as well as beech wood. The surface treatment doesn't represent complexity, also it can be processed dyes. It dries out less, is strong blunt the tool, is purely carve, sanded, has no tendency to a roughness, allows to carry out thinner carving as on the processing centers, and the manual tool. High impact strength, ability to a bend and absence breaks cause primary use ash-tree wood in production of products of the increased wear resistance and the increased accuracy of production - doors, coverings of a floor, panels, ladders, furniture, etc. It is possible to refer big gradation of color to shortcomings, however, removable toning of surfaces. Especially advantageously products in the rooms located on North side look.

Microroughnesses remaining after surface treatment of ash-tree wood make up R_m 32-40 microns, so finishing products made of it is able to give glossy shine of the surface taking into account vessels of an early zone of a year layer adding dullness.

Ordinary ash-tree wood is viscous, on mechanical properties, in particular, hardness radial (Brinell 1,8 [1]) is softer than oak wood. Optimum cutting angle is 200. Breed

belongs to average shrinkable woods. Averaged values of the coefficient of swelling / shrinkage (according to our data), %/%: radial Kr = 0,19; tangential Kt = 0,31; volume Kv = 0,52; wood density under normalized humidity W=12% ρ_{12} = 700,2 kg/m^3.

Ordinary ash-tree wood of regional growth has one more distinctive property - its humidity in just cut down state doesn't exceed 50%. Thus, in convective cameras of periodic action without artificial moistening the following physical and mechanical properties have decisive impact on technology of drying of an ash-tree: rather high density, considerable coefficients of shrinkage and low initial humidity of lumber.

Due to above designated circumstances it was decided not to adhere to traditional technology of drying as application of this technique in full to drying without steam isn't possible because of the absence of that that considerably extends process. Therefore because intensity and features of development of internal tension at convective drying without artificial moistening slightly others [2], it is necessary to use the so-called parabolic modes [3] adapted for convective drying (tab. 1). These modes include 4 stages with the initial heating and final wet-heat processing.

Previously process of drying was mathematically simulated, values of transitional humidity and other main regime parameters then are carried out practical production drying in the loading of 10 m^3 1-stack chamber are received. Thus, all volume was dried up for only three parties by soft modes: trial (3 dryings), control (2 dryings) and final (9 dryings) to acquire and fix experience in drying of infrequently used expensive breed. On the physical and mechanical properties ash-tree wood ordinary dries well, quickly enough, is a little inclined to face, superficial and internal cracking, a buckling in the cross plane and, in general, can be used by beginning technologists for acquisition of experience in drying of strong hardwoods.

Table 1

Modes of low-temperature dryings of ash-tree lumber in convective chambers without artificial humidification

Average humidity, %	Mode parameters	Thickness, mm	
		32	50
1	2	3	4
Soft modes (S)			
50-35	$t, ^0C$	58	48
	$\Delta t, ^0C$	4	4
	φ	0,81	0,79
35-25	$t, ^0C$	48	44
	$\Delta t, ^0C$	6	5
	φ	0,70	0,73
25-15	$t, ^0C$	60	54
	$\Delta t, ^0C$	9	8
	φ	0,61	0,64
<15	$t, ^0C$	75	68
	$\Delta t, ^0C$	23	19
	φ	0,34	0,37

Such tactics allowed to dry up wood evenly on lumber and stack section, without fistulas, cracks, a buckling and considerable residual tension, and further pasting to receive constructive, well holding a form, elements of any linear sizes.

As a result of activities we succeeded to reduce the average duration of the process by 25% - from 30 to 23 days for lumber 50 mm thick and from 21 to 15 days for lumber 32 mm thick.

Conclusions:

- the structural changes of the last two decades happening in wood processing branch, led to considerable replacement of the large enterprises with the small joiner's and furniture workshops capable quickly to react to changes of market conditions;

- such workshops processing insignificant quantity of lumber of different breeds and of different function, manage one-two dryers of small volume and often have no access to industrial technological steam;

- proposed parabolic drying modes without artificial humidification may be an alternative to the traditional modes for drying in steam-air medium.

References:

1. Ugolev B.N. Wood Science with the basics of forest merchandising. - Moscow: Moscow State Forestry University, 2001. - 336 pp.

2. Chernyshev A.N. Stress-strain condition of edged assortment when drying without steam: monograph. – Voronezh, VSFEA, 2005. - 80 pp.

3. Pat. RF № 2319915 C1 MKP7 V1/00 F28, 3/04. The method of lumber drying / A.N. Chernyshev, A.A. Filonov, applicant and patentee SEI HPE "VSAFT". Number 20061116335/06; application.12.05.2006 publl. 20.03.2008, Bull. № 30. - 4pp.

Date of sending: 05.12.2013

J11404-007

Kozionov V.A., Aldungarova A.K.

INFLUENCE OF COARSE INCLUSION ON CREEP OF CLAY SOILS AT CONFINED COMPRESSION

S.Toraigyrov Pavlodar State Universit, Pavlodar, Kazakhstan

L.N. Gumilev Eurasian National University, Astana, Kazakhstan

Introduction. When geotechnical studies for the construction of buildings and structures on eluvial soils widespread in the territory of the Republic of Kazakhstan, is often necessary to determine the mechanical properties of soils, representing a mixture of natural inclusions of rock debris with silty-clay aggregates, called in practice fragmental clayey soils [1]. Mechanical properties of soils such as the results of research essentially depend on the characteristics of their composition, structure, condition and aggregate inclusions. Despite the considerable amount of the research, their deformation patterns have not been studied adequately. This applies mainly to data on the rheological properties of these soils.

The aim of this work is to study the influence of the content features, the size of the inclusions and coarse aggregate state on the creep parameters of clayey soils under compression seal. Two series of studies: experimental soil testing and numerical simulation by finite element method (FEM).

The results of physical experiments. Experiments were performed in compression devices with synthetic mixtures of loam with moisture at the rolling $w_P = 0{,}158$, at the border point $w_L = 0{,}296$ and debris cover. To compile the test program was used multifactorial experiment planning theory. In constructing the matrix design of experiments the number of factors is assumed to be three. The numerical values of the factors varied on two levels (+1 and -1):

- X_1 (n) – the percentage of inclusions (-1… 0,2; +1… 0, 4);
- $X_2(d)$ – size inclusions druss (-1… $d =$ 0,5; +1… $d =$ 1,0);
- $X_3(w)$ – humidity aggregate (-1… $w =$ 0,205; +1… $w =$ 0,255).

Mechanical properties of evaluated druss modern instruments for nondestructive actions "Pulsar" and "Onyx". Preparation of soil samples from a mixture of loam and debris cover was carried out by layering them laying latching structure formed. During the run, the deformation of the soil samples in time $\varepsilon = f(p,t)$ the steps of applying loads p.

Typical results of the two tests in the form of creep curves $\varepsilon_t = f(t)$ and dependencies $\varepsilon_t = f(p,t)$ are shown in Fig. 1. The data show that the studied soils have pronounced rheological properties. The presence of coarse inclusions has a reinforcing effect on the value of creep strain and depending $\varepsilon = f(p,t)$ has nonlinear for various times.

To describe the deformation of soil in time used in the logarithmic approximation dependencies $\varepsilon_t = f(p,t)$ [2] (G.I. Pokrovsky formula), which under constant load has the form (1)

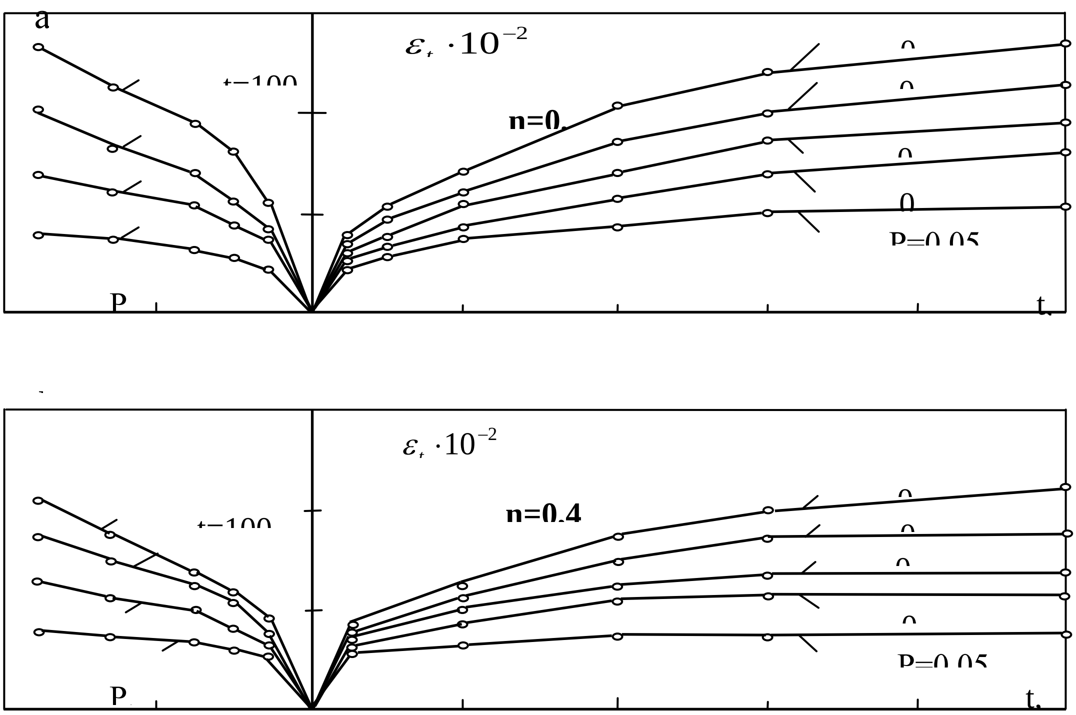
$$\varepsilon_t = Ap^K + Up^m \ln(t+1), \qquad (1)$$

were p,t – load level on the sample and time;

A,K,U,m – empirical parameters.

The first term expresses the conditional instantaneous nonlinear soil deformation, and the second - the nonlinear soil deformation, evolving in time, i.e. creep.

When determining the $A,К\ U,M$ isochronous curves aligned coordinates $Y = \ln\ p$, $X = \ln \varepsilon$. Typical results of such constructions are shown in Fig. 2.



a – at $n = 0$; b – at $n = 0{,}4$

Fig. 1 – Creep curves $\varepsilon_t = f(t)$ and depending $\varepsilon_t = f(p,t)$

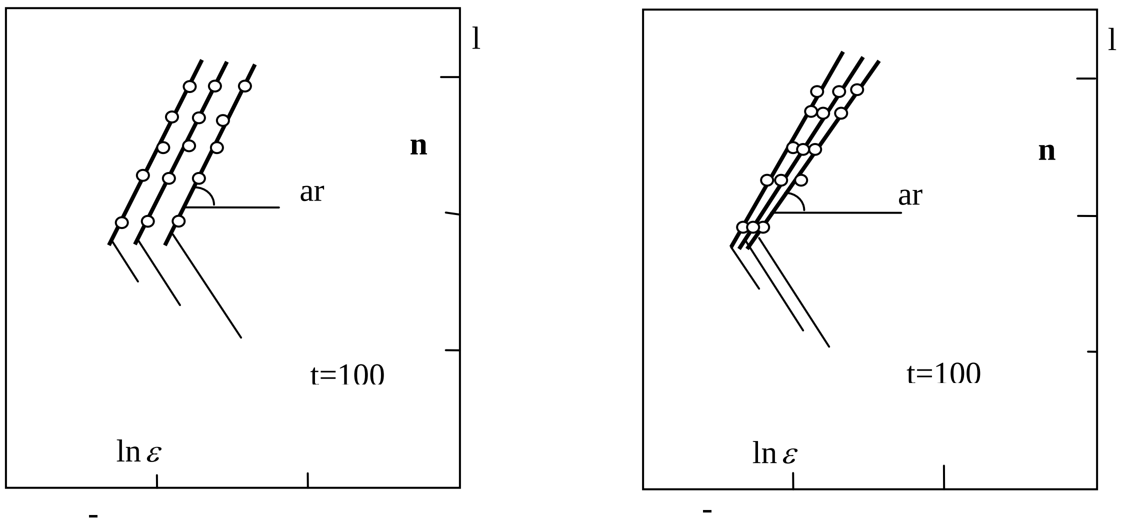


Fig. 2 – Dependencies $\ln\varepsilon_t = f(\ln p, t)$ at n = 0,0 and n = 0,4

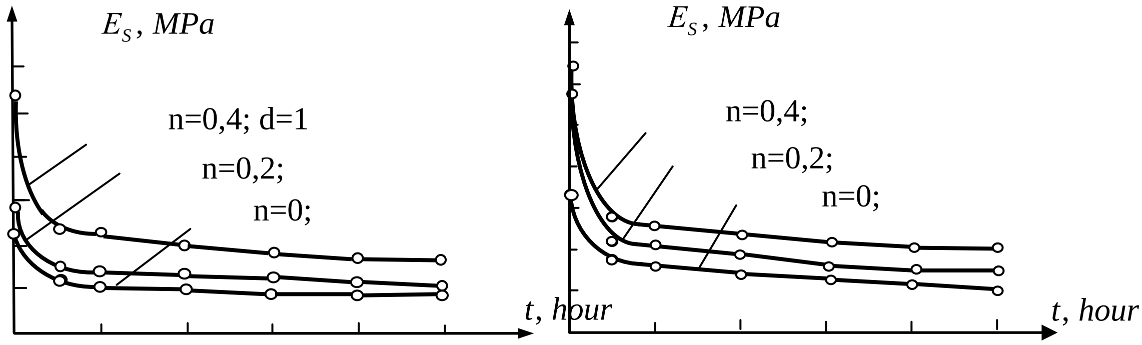
Table 1

Parameters of the nonlinear deformation of soil in time

Parameters of the nonlinear deformation	test data		
	n=0	n=0,2	n=0,4
Parameters conditionally instantaneous deformation			
a	$3{,}21 \cdot 10^{-3}$	$2{,}00 \cdot 10^{-3}$	$2{,}01 \cdot 10^{-3}$
K	0,256	0,329	0,261
creep parameters			
U	$4{,}09 \cdot 10^{-3}$	$3{,}21 \cdot 10^{-3}$	$1{,}99 \cdot 10^{-3}$
m	0,324	0,358	0,440

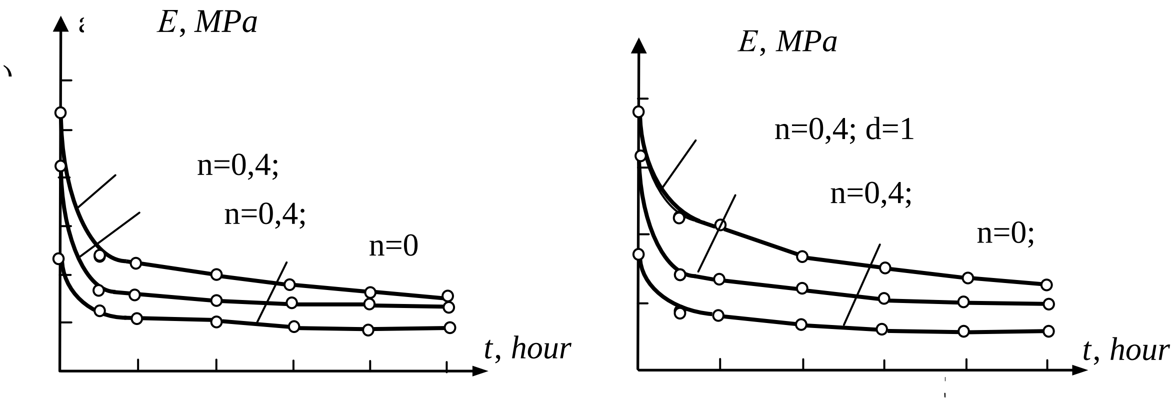
Analysis of Table 1 indicates a significant dependence of the parameters of creep of clayey soils on the content of coarse inclusions.

Fig.s 3 - 5 shows the dependence of the change in time of the compression modulus of deformation $E = f(t)$ for load steps p = 0.05 MPa for a number of combinations of parameters n, d, w. Their analysis indicates the existence of a very complex dependence of the form $E = f(n, d, w, p)$.



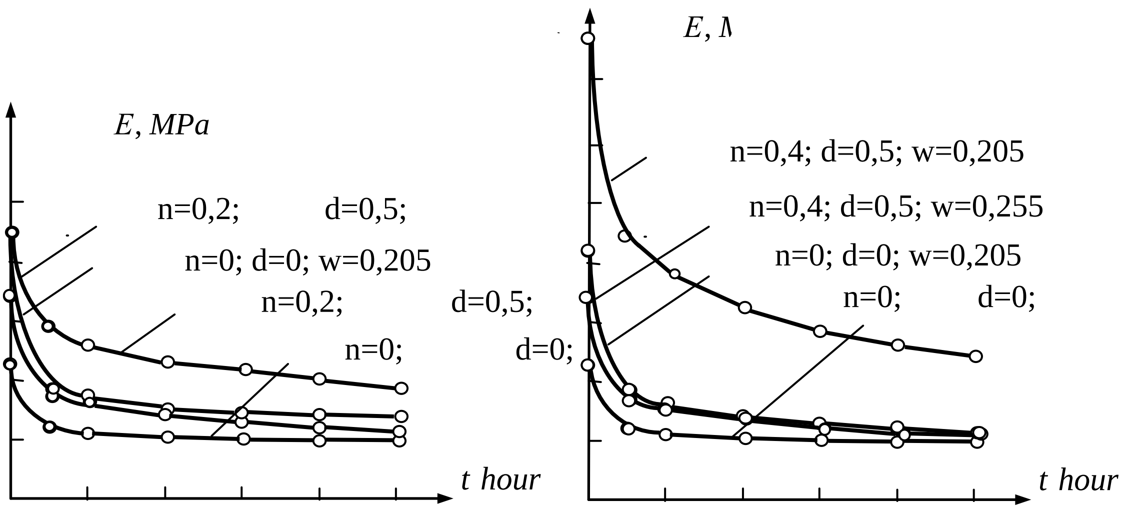
a – $E_S = f(t)$ at $w = 0{,}25$; b – $E_S = f(t)$ at $w = 0{,}20$

Fig. 3 – Effect of inclusions on the deformation modulus



a) – $E = f(t)$ at $w = 0{,}25$; b) – $E = f(t)$ at $w = 0{,}20$

Fig. 4 - Effect size inclusions on deformation modulus



a) – $E = f(t)$ at $n = 0{,}2,\ d = 5\ mm$; b) – $E = f(t)$ at $n = 0{,}4,\ d = 5\ mm$

Fig. 5 – Influence of humidity on the deformation modulus

Overall assessment of the results shows that the values of soil moisture w=20.5...25.5% with increasing inclusion content from 20 to 40% is clearly recorded growth of compression deformation modulus. Analysis of experimental data shows that with increasing aggregate size in the range studied deformation modulus increases slightly. The findings also indicate that an increase in the humidity range studied aggregate modulus of deformation, the general case, naturally decreases.

Dependence of $E = f(n, d, w, p)$ can be obtained by factor analysis. For example, the resulting data for conventionally stabilized instantaneous E_O and E_S during the time of compression deformation under load modules p = 0.05 MPa were obtained according

$$E_O = 1{,}7 + 0{,}73x_1 - 0{,}03x_2 - 0{,}96x_3 - 0{,}0063x_1x_2 - 0{,}18x_1x_3 + 1{,}5x_2x_3 + 0{,}71x_1x_2x_3\,, \quad (2)$$

$$E_S = 1{,}7 + 0{,}2x_1 - 0{,}1x_2 - 0{,}33x_3 + 0{,}05x_1x_2 - 0{,}075x_1x_3 + 0{,}625x_2x_3 + 0{,}125x_1x_2x_3\,. \quad (3)$$

In formulas (2) and (3) is usually $x_i = (X_i - X_{0i}) / \Delta X$. Here X_i - natural value of the factor ; X_{0i} - zero ; ΔX_i - change interval factors.

By analogy, the dependences $E_S = f(n, d, w, p)$ for different values p .

The results of mathematical modeling. In accordance with the scheme of the test load on the soil sample is passed through a die stages predetermined value (Fig. 6a). On the side faces of the sample boundary conditions are set - no horizontal displacement and the lower boundary - lack of vertical displacements. Placeholder for calculations and the inclusion of debris cover broke into finite elements (fragment breakdown is shown in Fig. 6b). The problem was solved by the finite element program SCAD using data of physical experiments.

When performing calculations FEM calculation models used two soils. Inclusions - model linearly deformable medium and deformation law aggregate described compression curve obtained according to the real test of the soil sample with n = 0 [3]. It was assumed that the stress state in the sample does not change in time, i.e. Poisson's ratio of the filler ν is constant, and no creep inclusions.

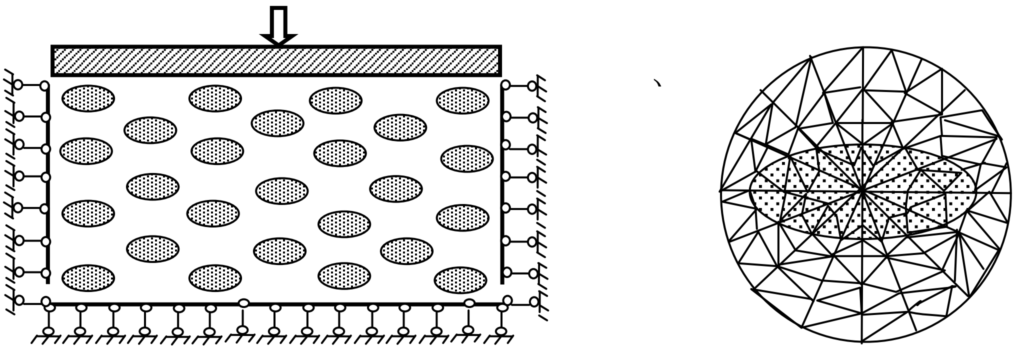
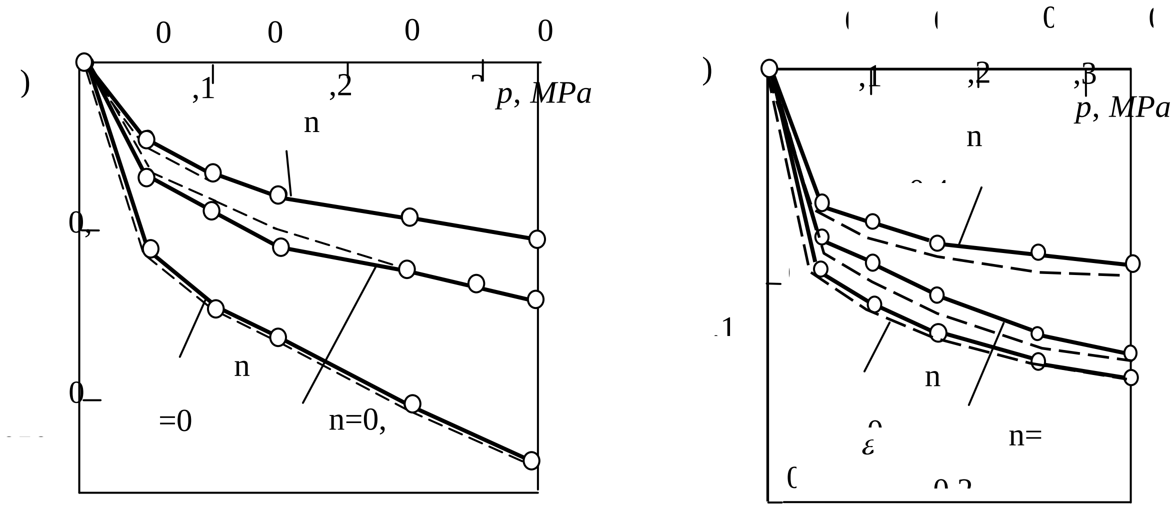


Fig. 6 – Design scheme of modeling soil compaction under confined compression

Fig. 7 presents data on the isochronous curves $\varepsilon = f(p,t)$ for various times obtained experimentally (solid line) and FEM calculation (dashed line).



a – at t = 100 hour; b – at t = 0,2 min.

Fig. 7 – Isochronous depending $\varepsilon = f(p,t)$

From Fig. 7 that the data of numerical simulation agree well with the results of physical experiments. Then the results of numerical modeling can build similar to Fig. 2 dependence and determine the parameters of lot U, m, a, K. Table 2 shows the results of experimental determinations and the calculated secant modulus of compression strain E_S (d = 0.5 mm; w = 0.205).

Analysis of simulation results showed that the stress distribution in the soil sample in the presence of coarse-grained inclusions in it is very heterogeneous (Fig. 8).

Table 2

Experimental and calculated values E_S

Load stage, MPa	test data			estimates		
	n=0%	n=20%	n=40%	n=0%	n=20%	n=40%
Secant modulus values of compression deformation of soil E_S, kPa						
0,05	1150	1823	2818	1131	1974	2627
0,10	1820	2952	3875	1829	3039	4026
0,15	2320	3444	4895	2268	4043	-
0,25	3040	5167	6458	3100	4890	-

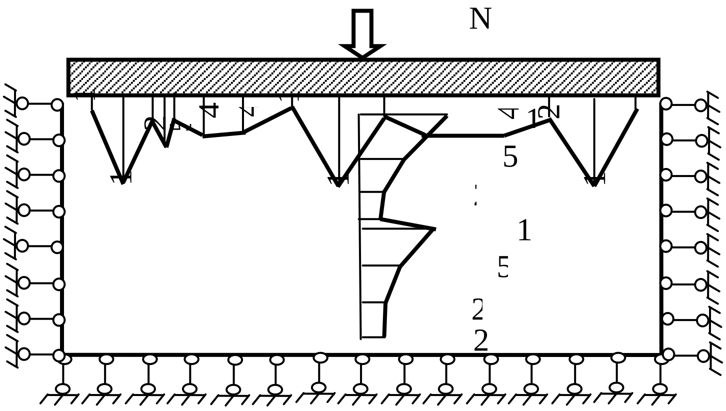


Fig. 8 – Plots of vertical stresses in the soil sample with n = 0,2

Distribution of vertical displacement of the sample is also heterogeneous. Therefore, the analysis of stresses and deformations in such soils is necessary to use them in terms of averaged values. With increasing loads on the ground it may occur localized areas of destruction. Therefore, this method of numerical calculation of deformation parameters valid for deformation predominantly clay soil under transient creep. Otherwise, there is the need for computational models for aggregate, taking into account the formation stages of steady and progressive course of clay soil over time.

Findings

1. The presence in the clay soils of coarse inclusions has a reinforcing effect on their creep parameters. It was found that these values depend on the content, size and condition of aggregate inclusions. Accounting for the actual structure of the soil reduces the computational foundations of precipitation over time, which increases the efficiency of the design decisions.

2. The presented method of numerical simulation of compression tests is recommended as a complement to existing methods for determining creep parameters of clayey soils with COARSE inclusions, especially at keeping them large rock rubble, where the use of standard laboratory and field geotechnical testing difficult or technically impossible.

References

1 Fedorov V.I.. Prognoz prochnosti I sgimaemosti osnovanii iz oblomochno-glinistih gruntov. M.: Stroiizdat, 1988. – 136 p.

2 Vyalov S.S.. Reologicheskie osnovi mehaniki gruntov. M.: Visshaya shkola, 1978. – 447 p.

3 Ter-Martirosyan Z.G., Mirnii A.YU.. Raspredelenie napryagenii i deformacii v neodnorodnom grunte s uchetom formi, razmerov i gestkosti vklyuchenii // Megdunarodnii gurnal «Geotehnika», 2010. № 3. – P. 21 – 27.

J11404-008

Ilin A.N., Gilyazidinova N.V.

USE THE SLAG CONCRETE IN BUILDING UNDERGROUND STRUCTURES AND MINES

Kuzbass State Technical University. T.F. Gorbacheva.

Kemerovo, street. Spring, 28, 650000

Abstract. In this paper we describe the use of slag concrete in the conditions of underground construction.

Key words: underground construction, blast furnace slag, fuel slag, concrete, supplements, strength, concretion, climbing shuttering.

Underground construction, owing to a number of the features, is obviously predisposed to use high-strength concrete. In underground construction strength of concrete is very important, but not the only defining factor. Water tightness and the durability are very important too. Durability and water tightness consisting of resistance to sulphatic aggression, resistance to leaching and still a number of less significant factors. In the construction of underground structures and mines used heavy concrete with small and large fillers.

Breakstone in Kuzbass become less and less, that's why the tendency of regular rise in prices is observed (about 30% in year). In the same time on dumps of Kemerovo region there is a large resource of waste of the metallurgical and fuel company - the ashes and slags. The chair of construction production and examination of real estate performed work on research of possibility to use of a breakstone from domain slag and mixes of ash and slag from thermal power plants for creation of heavy concrete, which is proposed to use for the manufacture of precast and monolithic structures for underground construction.

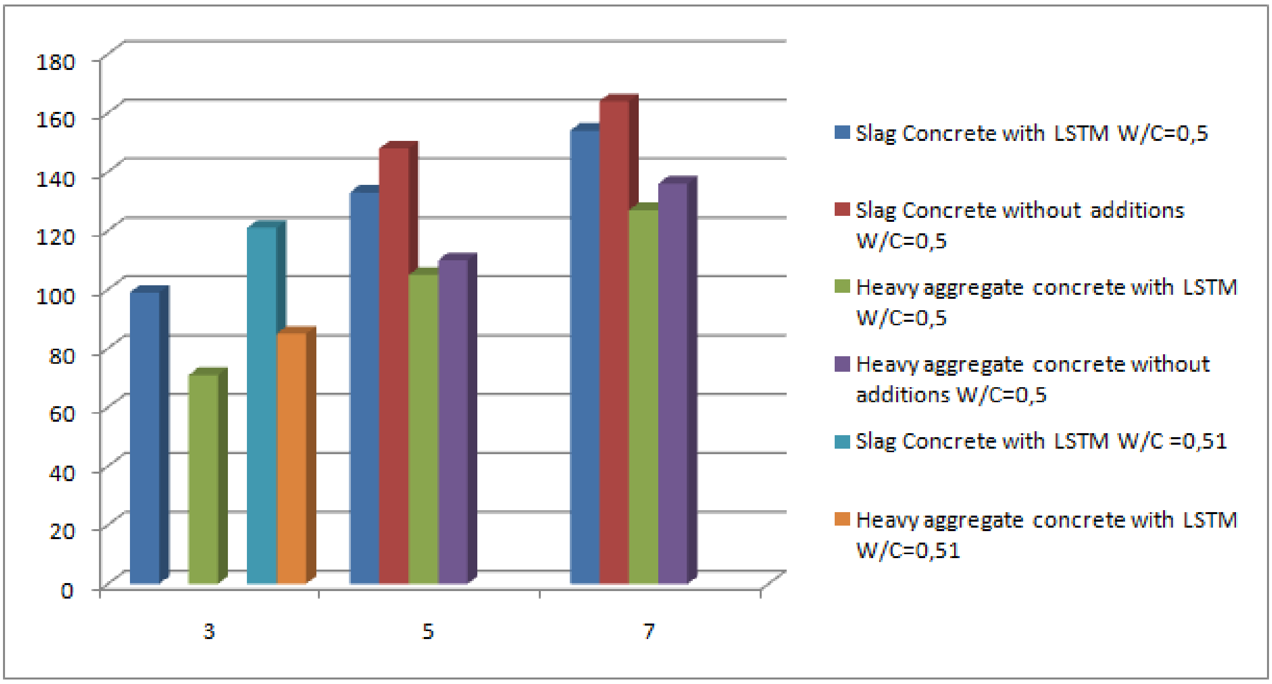
Prerequisite for creation high-quality ashslagconcrete was the analysis of physical and chemical slag's properties. A number of the indicators characterizing possibility of using a blast furnace slag as fillers of concrete and allowing to judge their hydraulic activity is established.

Construction Norms and Regulations 2.03.01*-84 "Concrete and reinforced concrete constructions" is recommend to use in the concrete only acid slags with basicity module less one. Slags of Kuznetsk contain in their structure from 37 to 39% of CaO, their module of basicity is 0,89, that's why they belongs to acid and can be used as fillers for concrete. Its module of hydraulic activity fluctuates from 0,34 to 0,4. On a quality indicator (abilities in finely shredded form to interact with water like cement) domain slags belong to the low-active. Their curing is provided only in the presence of cement clinker.

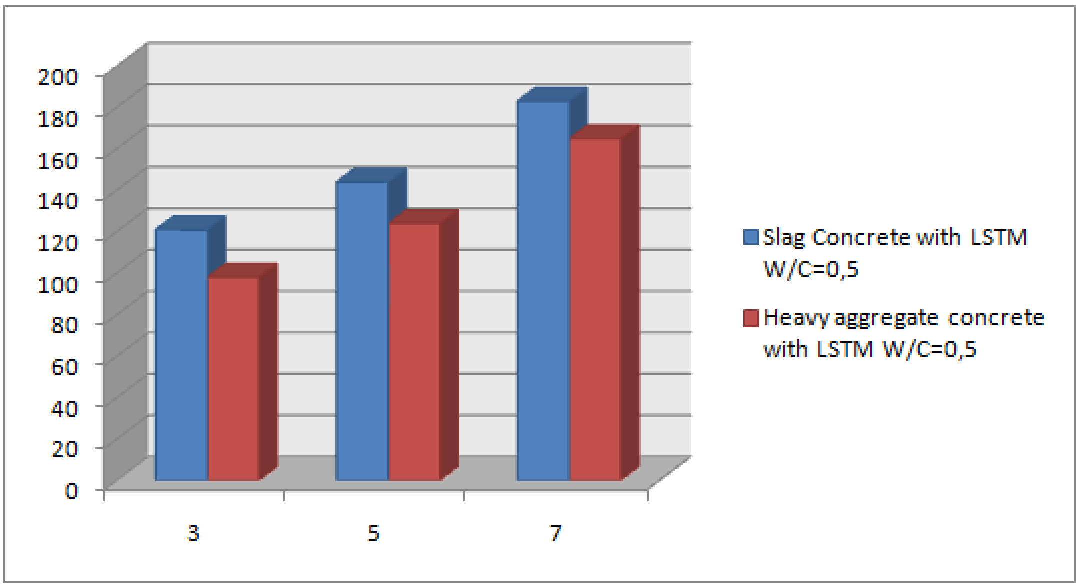
Domain slags on a chemical composition come nearer to a portlandtsement, but it contains the increased amount of silicon dioxide, alumina and less - calcium oxide. Slag fillers aren't inert, they in a contact zone react with related to them cements, this leads to growth uniformity and to improvement of structure of concrete.

The most part of the monolithic concrete used in construction of underground structures and mines, keeps in underground structures and hardens at lowered temperatures. Normal conditions of curing of concrete: temperature is +15-+20 °C and at relative humidity of 90-100%. With decrease in temperature of keeping the concrete strength increases more slowly, as established by numerous researches. It is interesting to research the change of concrete strength on slag breakstone at various temperature of storage, in particular at +5 °C, characteristically to underground mine construction. For this purpose, experiments were conducted in which samples - cubes, made of slug concrete with a different composition with fillers LSTM and LSTM+ CaC12, and control of normal heavy concrete, partially placed in a cooling chamber and kept at a temperature of 5 ± 2 ° C and partially stored in normal conditions.

Determination of durability of twin samples was carried out after their visual survey at the age of 3, 5 and 7 days at curing temperatures + 5^0C (pict. 1) and + 15^0C (pict. 2).

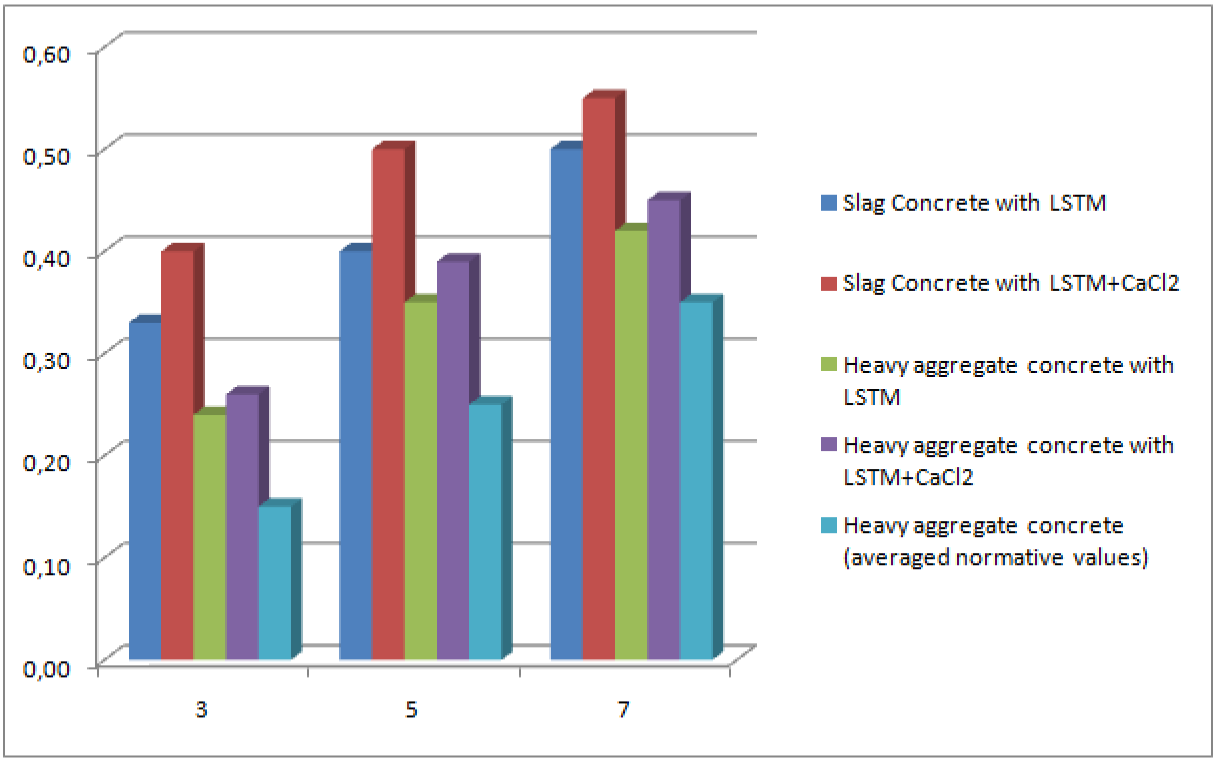


Pict.1 Tests results of concrete of various compositions, when the curing temperature was +5 ^{0}C

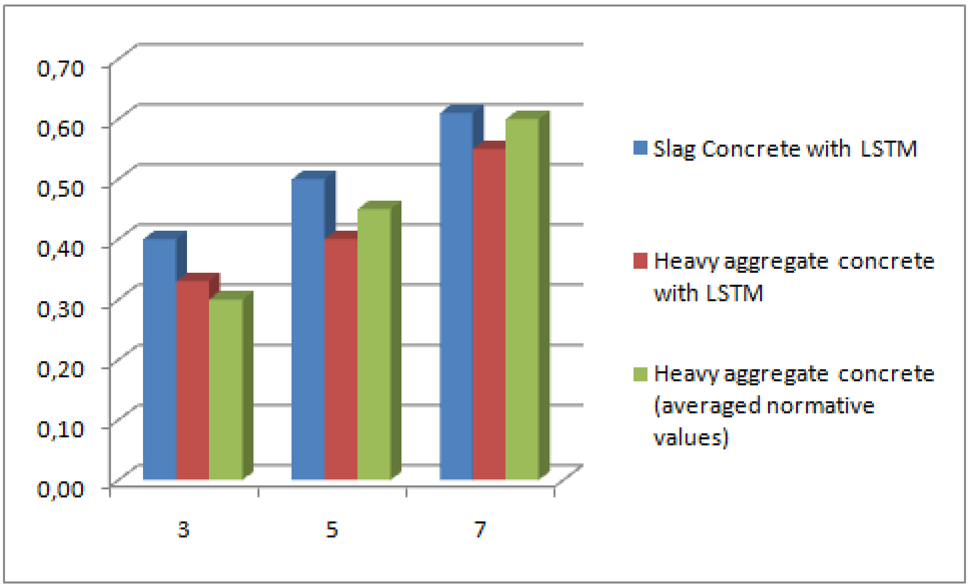


Pict.2 Tests results of concrete of various compositions, when the curing temperature was +15 ^{0}C

Comparisons tests of concrete with various structures and standard characteristics of relative concrete strength on the natural fillers, hardening at the same temperature according to normative literature (pict. 3,4).



Pict.3 Tests results of concrete, when the curing temperature was +5 ^{0}C



Pict.4 Tests results of concrete, when the curing temperature was +15 ^{0}C

As can be seen from the graphs, the strength characteristics of slug concrete not only exceed the normative characteristics of heavy concrete, but also have higher absolute values than the same indicators of concrete on natural fillers.

Introduction in composition of concrete of 2% of CaCl2, according to normative literature, provides increase of concrete strength at lowered temperatures to 75% of the design strength of the concrete hardening in normal conditions. The actual increase of strength made, on experimental data, for heavy concrete of 75-87%, and for constructive concrete on slag breakstone - 92-133%. It follows that slag concrete more effective to use at lowered temperatures, then common-on-garden types of concrete on natural materials.

The question of expediency of use a slag concrete in a sliding timbering evoke a special interest. According to data of technical and normative literature, concrete applied in a sliding timbering must abide by requirements, among which are: mobility of concrete mix from 5 to 9 cm, precipitation of a standard cone, strength providing possibility of release concrete from a timbering - 0,15-0,3 MPas; time of achievement by concrete an ontimbering strength 4-12 h, the speed of movement a timbering of about 2-8 cm/h (50-200 cm/days).

For determination an expediency of using a slug concrete for present purposes in a removable metal timbering was lay down concrete mix by mobility for about 8-9 cm and condensed with a spiting method. For the purpose of improvement the rheological characteristics of concrete mix the LSTM was entered into its structure in number of 0,15% of the mass of cement in terms of solid. Concrete was maintained in the cold camera at a temperature about +5 - +7 °C. That imitated conditions of underground mine constructing. After 3,5 hours it was exempted from a removable timbering. It corresponded to the speed of movement of a timbering about 200 cm per day. Visual survey a sample showed that on its surface there were no shrinkable cracks, spall and other defects.

The tool technique determination of concrete strength at early age is absent that's why its suitability for application in a sliding timbering was defined by a way of a palpating and test for local compression (collapse).

It is accepted that the speed of movement a sliding timbering is appointed correct if after a palpating on concrete it isn't observed a deep hollow. Experiments confirmed compliance of studied composition of concrete to the specified requirement. The cubical and prismatic concrete strength was defined by test of concrete for the collapse.

It is known that the temporary resistance of concrete to collapse (1)

$$\sigma_{S.COK} = 1{,}5\sigma_{B.U.} = 1{,}5 * 0{,}8\,\sigma_{U} = 1{,}2\,\sigma_{U}\,\sigma_{S} \qquad (1)$$

where

$\sigma_{B.U}$ - prismatic concrete strength

σ_{U} - cubical concrete strength

whence cubical concrete strength (2)

$$\sigma_{U} = \sigma_{S.COK}/1{,}2 \qquad (2)$$

For definition $\sigma_{S.COK}$ on the top open surface of a sample, in its center, were established two stamps - one with pillar of 1,01 cm^2, the second - 0,39 cm^2 were established. Loading was transmitted through them in steps on concrete.

During tests was established that at local loading of 5,94 kg/cm in concrete under a stamp and on border with it there are no plastic deformations; with a loading growth to 7,92 kg/cm2 - stamp depth in concrete was 0,5 mm; at loading of 10,25 kg/cm2 - 2,8 mm. Thus, critical, answering to temporary resistance a collapse, it is possible to consider the loading equal to 6 kg/cm2 with some safety reserve. It means that the cubical concrete strength on 3-4 h after its laying in a timbering will make σ_{U} =6:1,2 = 5 KG/CM and that received value exceeds the size of most demanded ontimbering concrete strength during the work in a sliding timbering more than 1,6 times.

Therefore, using a constructive concrete with fillers from mix of domain and fuel slags in a sliding timbering expediently and rather effectively.

Literature:

1. Zotkin A.G. Concrete and concrete’s structures. - M.: Phoenix. 2012. - 335 c.

2. Dinescu T. Climbing shuttering. - M.: Stroiizdat.1975. – 527 c.

Статья отправлена: 14.03.2014г.