The results prove that a bent-weld-and-closed profile is the most effective one according to its characteristics.

In conclusion it is important to say that the upper bearing type truss is the most economically sound type due to 10 per cent lower material consumption for each truss, when the span is 18 meters. Bend-weld-and-closed profile is the most effective, among the studied, due to its lower mass and section area.

REFERENCE

1. Типовая документация на конструкции, изделия и узлы зданий и сооружений. Сер. 1.460.3-23.98. Стальные конструкции покрытий производственных зданий пролётами 18, 24 и 30 м из замкнутых гнутосварных профилей прямоугольного сечения с уклоном кровли 10 %. – Вып. 1.
2. Металлические конструкции. Общий курс : учеб. для вузов / Е.И. Беленя [и др.] ; под общ. ред. Е.И. Белени. – 6-е изд., перераб. и доп. – М. : Стройиздат, 1986. – 560 с., ил.
3. Вариантное проектирование и оптимизация стальных конструкций. – М. : Стройиздат, 1979. – 319 с., ил.
4. Лебедева, Н.В.Фермы, арки, тонкостенные пространственные конструкции : учеб. пособие / Н.В. Лебедева. – М. : «Архитектура-С». 2006. – 120 с., ил.

**UDC 691-405**

## MIXTURES AND THEIR CHARACTERISTICS

***NATALLIA KHLUD, DZMITRY SHABANAU***
**Polotsk State University, Belarus**

*Here the mixture, which used for filling up the pores of macadam basis and promoting receiving the monolithic basis with the minimum of shrink deformations and with the help of a vibrodelivery method and penetration viscometer are considered.*

The aim of our research is cement dough, the methods of its best arrangement between macadam base, as the aim of our research – to create a monolith, which will be strong, rigid, and non-shrink. It is an important characteristic of the highway.

We can determine viscosity of a raw mix by the penetration viscometer. The principle of operation of the PM-3 penetration viscometer (Fig. 1) is the following:

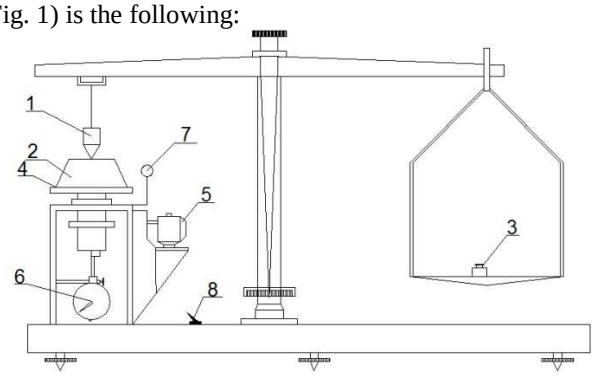


Fig. 1. Penetration viscometer PM-3 (1 – cone; 2 – model; 3 – scale with weightes; 4 – little table; 5 – electric motor; 6 – indicator; 7 – lamp; 8 – switch)

The principle of operation of the penetration viscometer shows that by results of measurements on the penetration viscometer the limit tension of shift $\tau_0$, and the operating tension of shift $\tau$ which part, except $\tau_0$, is the dynamic component depending on viscosity and a gradient of speed in a shifted layer is defined not. Thus, for definition of rheological characteristics by results of measurements on the penetration PM-3 viscometer it is necessary to know the character and the sizes of the shift area of the studied environment at movement in it the conic indicator, and also the size of a gradient of speed of shift [1, p. 9].

Let's consider the deformation scheme which is of great importance as it is the characteristic for the majority of the raw mixes applied in production of construction materials. Figure 2 shows that the particles of the environment adjacent to a surface of a cone, move together with the last, and at a certain distance from a cone surface where a trajectory of movement of particles pass to horizontals, they aren't mobile. Therefore, in all deformable volume there is a shift. Thus the sliding surface I-I, dividing deformable and not deformable volumes

of the environment, is the cone surface which top coincides with top of a conic indenter. Tags on horizontal layers of the material, formed by immersion of a thin steel plate in strictly vertical direction in a sample before introduction of a cone (Fig. 2). Therefore, particles of the environment move vertically. [1, p 12]

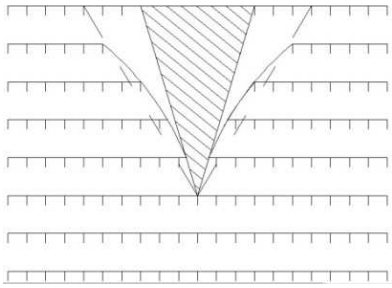

Fig. 2. Trajectory and diagram speeds of movement of particles
at cone immersion in clay and cement dough; cement and sand solution, silicate mix

At separate concreting of designs by vibrodelivery way it is necessary to use mixtures with grains of the different diameter, answering to the requirements shown to them, as to materials for concrete. However the major additional technologies property which grains with the maximum diameter have to have at separate concreting, their ability to pass cement dough in intergrain space is. In steam channels of filling up from grains as a peculiar incompressible viscous liquid with determination mobility can identify movement with the maximum diameter of cement dough from filtration viscous liquid in the porous environment. One of parameters of the porous environment, characterized its ability to pass through itself viscous liquids, is hollowness.

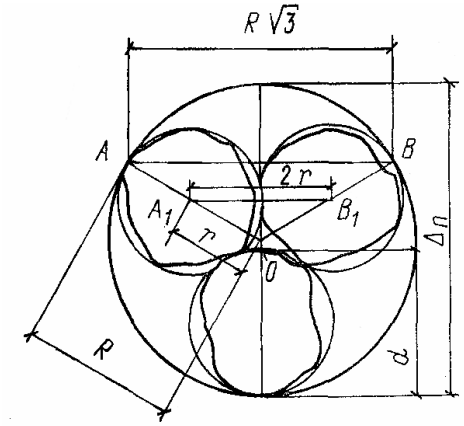


Fig. 3. Arrangement of grains of sand in a round time at formation of a steady wedge

The meaning of optimization of granulometric structure mixed knitting is defining when construction materials are receiving. As the powders mixed from particles of different types and the sizes, which form spatial structural units clusters that conducts to streamlining of disperse system. The maximum instability is observed on the boards of the section of structural units. Therefore, it is necessary to consider their qualitative and quantitative structure, depending on the purpose of the mixed powders.

The models of the new class «Mixture-mixture-feature», offered in works is perspective are used for the solution of tasks of the analysis and optimization of the mixed knitting.

Granulometry of powders – interdependent factors form «mixture».

Average values of results of explosive durability in points of the plan are shown in tables (for powders without lime table 1.1, from 10 % of lime table 1.2, from 30 % of lime table 1.3). Values of explosive durability are expressed in PA.

Table 1.1 – for powders without lime

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| 2,69 | 3,12 | 2,19 | 2,35 | 2,34 | 2,71 | 2,65 | 2,28 |

| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|
| 2,56 | 2,17 | 2,24 | 2,78 | 2,35 | 2,74 | 2,70 |

Table 1.2 – for powders from 10 % of lime

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| 3,63 | 3,99 | 3,25 | 2,86 | 2,69 | 3,38 | 3,61 | 3,48 |

| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|
| 2,83 | 2,73 | 2,95 | 2,86 | 3,04 | 3,39 | 2,93 |

Table 1.3 – for powders from 30 % of lime

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| 4,52 | 4,80 | 4,42 | 4,10 | 3,61 | 3,67 | 3,51 | 3,60 |

| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|
| 3,65 | 4,08 | 3,95 | 4,06 | 4,19 | 3,56 | 3,43 |

From the tables it is obvious that it is possible to regulate structure of a mix and to select the most favorable structure by means of composition change of powders [2].

The packings of spherical particles modeling monodisperse silica gels of varying density are constructed by the Monte Carlo method. Each model contains 8000 particles in a cube with periodic boundary conditions. Models with densities (extents of space filling) $\eta = 0,59$ and $\eta = 0,37$ were studied in detail. For quantitative analysis of the structure of empty interparticle space, Voronoi-Delaunay geometrical constructions are used. By analogy with the mercury porosimetry method, the «intrusion» curves, indicating the fraction of the pore volume accessible for a probe of the given size are built. The results of a standard analysis of these curves and the real arrangement of interparticle space in these models are discussed. The approach using the numerical simulation and the geometrical method suggested for model analysis is a promising trend in structural studies of porous materials.

Atomic arrangement is a traditional goal of structural studies. In recent years, however, increasing attention has been paid to another aspect of structure, namely, empty interatomic space. Problems of this kind show promise of interesting applications such as diffusion studies in glasses or chemical potential calculations in liquids. Mass transfer in corpuscular porous materials is a broader application of this aspect of structural research. Disordered packings of spherical particles are rational structural models for such materials; therefore, methods for model construction and analysis elaborated in the physics of fluids and glasses for atomic systems prove to be useful for this problem as well.

For mass transfer in porous materials, it is essential for the micro- and macrostructural problems to be interpenetrated. It is necessary to have a clear understanding of the structure of individual cavities, on the one hand, and to handle the whole system of pores, which is a macroscopic object, on the other. Traditionally, theoretical investigations deal with only one of these problems; the other is treated in a rough approximation. This is partly due to the fact that the pore microstructure may not be quantitatively defined in cases other than elementary. For example, in systems of spherical particles, the simplest pores are configurations of several spheres. In previous works, typical configurations were chosen to be the unit cells of particular crystal lattices. For the unit cell, one can easily use the unit cell approach to the whole system, which is rather problematic, because the majority of the compounds under study are noncrystalline. In another approach admitting the existence of a single pore system, the starting construction is a net of pore nodes (cavities) and bonds (narrow throats). Here problems of different kinds arise. First, the microstructure of the net nodes and bonds, performing the role of the local pores and windows between them, is unknown. Second, the structure and connectivity of the net itself are not clear. No physically justified answers to these questions can be given [3].

At research of the received mixtures, the results of structural durability allow to choose optimum pickings and to pick up mixtures with adjustable steam channels. Features of granulometric mixes structure and existence of steam channels in their structure allow to use a vibrodelivery way of concreting. For similar structure of mixes the penetration method of mixes with different granulometric structure is used and optimization on $D > 40$ d is carried out.

In further researches it is planned to use and cement and sand solutions for concreting of the bases, but additional researches to avoid jamming of structures are necessary.

REFERENCES

1. Определение реологических характеристик на пенетрационном вискозиметре / Кафедра «Производство строительных изделий и конструкций // Расчет реологических характеристик по экспериментальным данным, полученным на пенетрационном вискозиметре. – 1983. – С. 8–19.
2. Формирование макроструктуры искусственных строительных конгломератов / Строительство и архитектура // Математические модели типа «смесь-смесь-свойство». – 2013. – С. 13–14.
3. Исследование структуры пор в компьютерных моделях плотных и рыхлых упаковок сферических частиц / В.П. Волошин [и др.]. – 1999.