# GEOMETRIC MODEL OF THE DEPENDECE OF PHYSICAL AND MECHANICAL PROPERTIES OF BITIMEN CONCRETE ON FOUR PARAMETERS IN BN- CALCULATION

A. Bumaga

***Summary.*** **The paper gives a geometric model and a point formula of the dependence of strength limit while bitumen concrete pressing on four parameters: tar viscosity, polymer concentration in bitumen, activator concentration and operation temperature of bitumen concrete.**

***Keywords:*** **geometric model BN-calculus, asphalt, concentration, temperature.**

*Formulation of the problem.* Bituminous - the most common road-building material. On the pavement strength is influenced by many parameters, adjusting which can be asphalt-concrete required for these conditions, quality. The main physical and mechanical characteristics of asphalt-concrete based on bitumen are: tar viscosity, concentration of polymer in bitumen; end-ntratsiya activator and operating temperature asphalt. The main is characteristic of assessing the quality of asphalt is ultimate tensile strength in compression. Therefore, to assess the quality of the asphalt is important to determine the model depending border compressive strength of tar viscosity, concentration of polymer activator concentration and operating temperature asphalt.

*Analysis of recent research*. . To simulate the physical and mechanical properties of asphalt used in practice regression analysis. In [1] we have analyzed several theses [2-4] associated with the optimization of the properties of asphalt, for mathematical modeling which was used regression analysis and found significant deviations from the original data.

In the field of geometric modeling based on mathematical apparatus "BN-calculus" [5], the author has conducted similar research before that were outlined in [6].

*The wording of Article purposes*. To develop mathematical-based apparatus "BN-counting" algorithm calculated for you-mentioned geometric models depending border compressive strength of tar viscosity, concentration of polymer activator concentration and temperature.

*Main part.* The proposed building geometric model-Wan based on experimental studies (Table. 1) depending border compressive strength of four parameters: viscosity tar - $C_{30}^{10}$, concentration dropout polyvinyl chloride - $C_m$ PVC, con-centration of activator surface mineral powder - $C_m$ KM-MG and temperature samples fine dohtebetonu who were led in on [2].

Table 1.

Experimental data depends border compressive strength from four options.

| № п/п | $\tilde{N}_{30}^{10},\tilde{n}$ | $C_m$,% ПВХ | $C_m$,% КМ-МГ | $R_0$, МПа | $R_{20}$, МПа | $R_{50}$, МПа |
|---|---|---|---|---|---|---|
| 1 | 52 | 0,5 | 0 | 4,9 | 1,8 | 0,5 |
| 2 | 52 | 0,5 | 0,5 | 5,6 | 2,0 | 0,6 |
| 3 | 52 | 0,5 | 1,0 | 5,8 | 2,4 | 0,8 |
| 4 | 52 | 1,25 | 0 | 5,5 | 2,9 | 1,0 |
| 5 | 52 | 1,25 | 0,5 | 5,3 | 2,7 | 0,95 |
| 6 | 52 | 1,25 | 1,0 | 6,0 | 3,0 | 1,2 |
| 7 | 52 | 2,0 | 0 | 5,6 | 2,2 | 0,7 |
| 8 | 52 | 2,0 | 0,5 | 6,0 | 3,0 | 0,8 |
| 9 | 52 | 2,0 | 1,0 | 7,3 | 2,9 | 1,0 |
| 10 | 130 | 0,5 | 0 | 7,3 | 3,0 | 1,1 |
| 11 | 130 | 0,5 | 0,5 | 7,5 | 3,1 | 1,0 |
| 12 | 130 | 0,5 | 1,0 | 7,6 | 3,2 | 1,0 |
| 13 | 130 | 1,25 | 0 | 7,3 | 2,9 | 0,9 |
| 14 | 130 | 1,25 | 0,5 | 10,0 | 4,0 | 1,3 |
| 15 | 130 | 1,25 | 1,0 | 8,6 | 3,8 | 1,2 |
| 16 | 130 | 2,0 | 0 | 9,8 | 4,1 | 1,0 |
| 17 | 130 | 2,0 | 0,5 | 11,0 | 5,1 | 1,4 |
| 18 | 130 | 2,0 | 1,0 | 10,2 | 4,9 | 1,3 |
| 19 | 208 | 0,5 | 0 | 7,1 | 3,0 | 0,9 |
| 20 | 208 | 0,5 | 0,5 | 8,0 | 3,5 | 1,2 |
| 21 | 208 | 0,5 | 1,0 | 9,2 | 3,8 | 1,3 |
| 22 | 208 | 1,25 | 0 | 8,7 | 4,3 | 1,3 |
| 23 | 208 | 1,25 | 0,5 | 9,7 | 4,5 | 1,5 |
| 24 | 208 | 1,25 | 1,0 | 10,2 | 4,9 | 1,6 |
| 25 | 208 | 2,0 | 0 | 9,2 | 3,8 | 1,2 |
| 26 | 208 | 2,0 | 0,5 | 10,1 | 4,2 | 1,5 |
| 27 | 208 | 2,0 | 1,0 | 12,0 | 5,4 | 1,6 |

To better understand the present geometric model, which depends on four parameters in three stages. First, uv'yazhemo dependence border compressive strength activator concentration surface concentration of mineral powder and crushed stone PVC in the viscosity and temperature tar 52s 0°C (Fig. 1). As the number of points of reference and generators arc is three, for use geometric modeling point equation parabola that passes through three points [7]. The resulting surface is

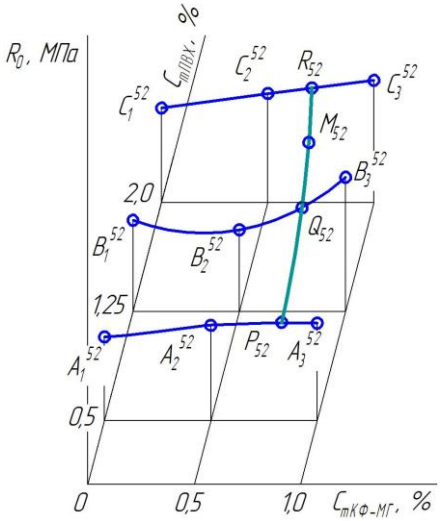


Fig. 1. Linking the two parameters

actually a segment of the surface type "loupe" and expressed the following sequence of analytical dependencies as a point of new equations:

$$\begin{cases} P_{52} = A_1^{52}\bar{u}\left(1-2u\right) + 4A_2^{52}\bar{u}u + A_3^{52}u\left(2u-1\right), \\ Q_{52} = B_1^{52}\bar{u}\left(1-2u\right) + 4B_2^{52}\bar{u}u + B_3^{52}u\left(2u-1\right), \\ R_{52} = C_1^{52}\bar{u}\left(1-2u\right) + 4C_2^{52}\bar{u}u + C_3^{52}u\left(2u-1\right), \\ M_{52} = P_{52}\bar{v}\left(1-2v\right) + 4Q_{52}\bar{v}v + R_{52}v\left(2v-1\right). \end{cases} \quad (1)$$

Similarly segments defined surface boundaries that reflect dependence compressive strength activator concentration surface concentration of mineral powder and crushed stone PVC viscosity at 130s and 208s.

Associate third parameter of the previous two. To do this three times to perform preliminary "magnifying glass" tar viscosity at 52, 130 and 208 and all this at asphalt 0°C (Fig. 2).

With geometric scheme (Fig. 2) shows that the supporting contour segment hypersurface are three segments Generating arc surface type "dandruff". As the number of basic circuits is three, use as a hypersurface generatrix parabola curve of 2nd order which will be held at 3 points, forming a "hiperdandruff ":

$$\begin{cases} M_{52} = P_{52}\bar{v}\left(1-2v\right) + 4Q_{52}\bar{v}v + R_{52}v\left(2v-1\right), \\ M_{130} = P_{130}\bar{v}\left(1-2v\right) + 4Q_{130}\bar{v}v + R_{130}v\left(2v-1\right), \\ M_{208} = P_{208}\bar{v}\left(1-2v\right) + 4Q_{208}\bar{v}v + R_{208}v\left(2v-1\right), \\ N_0 = M_{52}^0\bar{w}\left(1-2w\right) + 4M_{130}^0\bar{w}w + M_{208}^0w\left(2w-1\right). \end{cases} \quad (2)$$

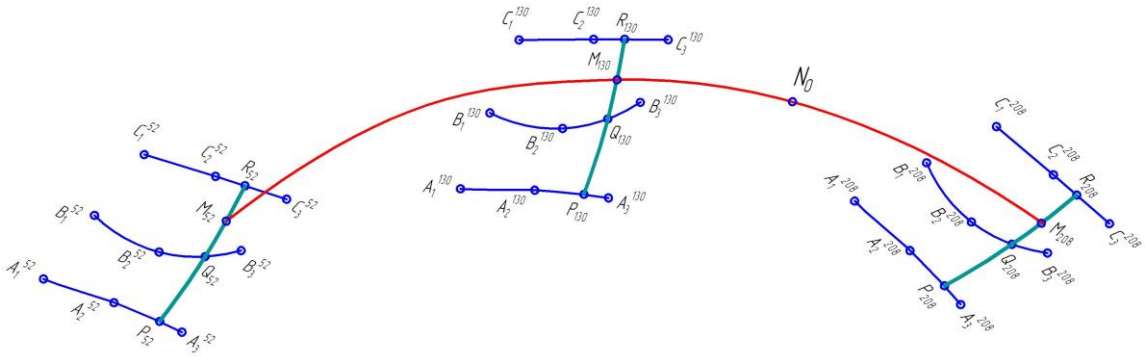


Fig. 2. Linking the three parameters.

Similarly, we get point segments hypersurface equation describing the process depends border compressive strength at 20°C and 50°C.

Associate fourth parameter of the previous three. To do this, use three times the previous "hiperlupu" at 0°C, 20°C and 50°C (Fig. 3). In this case, there are three paths supporting Generating hypersurface and generatrix - is the arc of a parabola 2nd order passing through 3 points. This se-

quence dependency analysis is as follows:

$$\begin{cases} N_0 = M_{52}^0 \bar{w}(1-2w) + 4M_{130}^0 \bar{w}w + M_{208}^0 w(2w-1), \\ N_{20} = M_{52}^{20} \bar{w}(1-2w) + 4M_{130}^{20} \bar{w}w + M_{208}^{20} w(2w-1), \\ N_{50} = M_{52}^{50} \bar{w}(1-2w) + 4M_{130}^{50} \bar{w}w + M_{208}^{50} w(2w-1), \\ T = N_0 \bar{t}\,(1-2t) + 4N_{20} \bar{t}t + N_{50} t(2t-1). \end{cases} \tag{3}$$

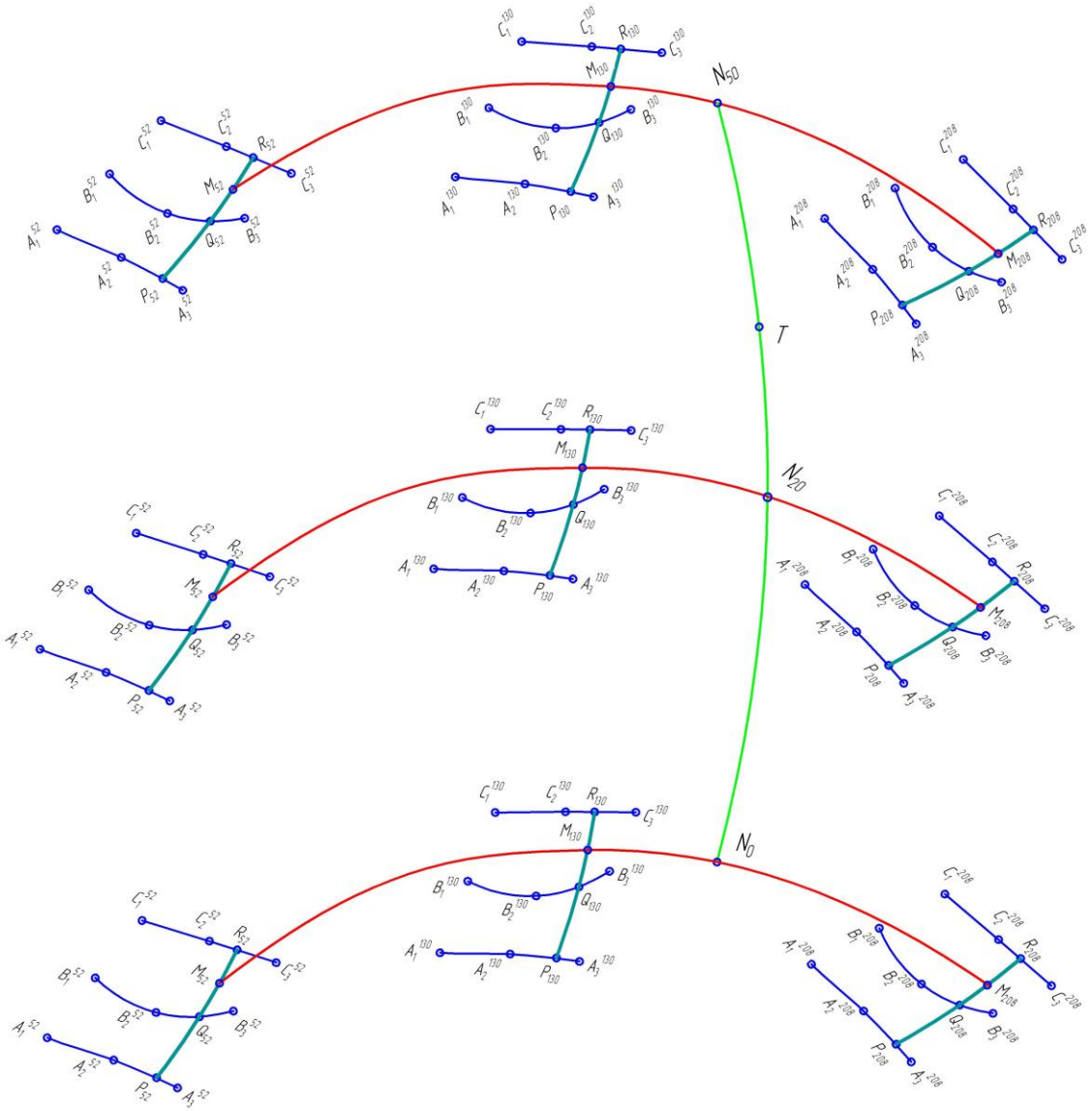


Fig. 3. Linking four parameters.

Thus, we obtain an algorithm calculated the geometric models depending border compressive strength on the concentration of dropout PVC, surface activator concentration of mineral powder, viscosity and operating temperature tar asphalt, which, under defined parameters *u*, *v*, *w*, *t* ..

As can be seen from the set point equations (1), (2) and (3) all three points are connected by means of consistency parabola equation 2nd order,

defined by three points, which greatly facilitates the programming of the proposed calculation algorithm.

*Conclusions*. The paper presents an algorithm for determining the estimated geometric models depending border compressive strength of four options, as an example of opportunities BN-calculus for multi geometric modeling phenomena and processes that can reduce the number of necessary and expensive experiments for research and analytical description of the properties of asphalt required.

Literature


1. *Бумага А.І.* Теоретические основы геометрического моделирования физико-механических свойств асфальтобетонов методами БН-исчисления / А.В. Найдыш, Е.В. Конопацкий, А.И. Бумага// Науковий вісник Мелітопольського державного педагогічного університету імені Богдана Хмельницького. Серія: Математика. Геометрія. Інформатика / гол. ред. кол. А.В. Найдиш. – Мелітополь: МДПУ ім. Б. Хмельницького, 2014.– Т.1. – С.111-117.
2. *Ходун В.Н.* Дёгтебетоны с комплексно-модифицированной микроструктурой: дис. … канд. техн. наук: 05.23.05 / Ходун Владимир Николаевич. – Макеевка, 1999. – 146 с.
3. *Рыбалко И.Ф.* Минеральный порошок из шлама нейтрализации травильных растворов: дис. … канд. техн. наук: 05.23.05 / Рыбалко Иван Федотович. – Макеевка, 1999. – 137 с.
4. *Самойлова Е.Э.* Дорожные асфальтобетоны с комплексно-модифицированной микроструктурой с использованием реакционно-способного термопласта Элвалой АМ: дис. … канд. техн. наук: 05.23.05/ Самойлова Елена Эдуардовна. – Макеевка, 2007. – 171 с.
5. *Найдиш В.М.* Алгебра БН-исчисления / В.М. Найдыш, И.Г. Балюба, В.М. Верещага // Прикладна геометрія та інженерна графіка: міжвідомчий науково-технічний збірник. – Вип. 90. – К.: КНУБА, 2012. – С. 210-215.
6. *Бумага А.І.* Геометричне моделювання фізико-механічних властивостей дьогтебетону / А.І. Бумага // Будівництво та техногенна безпека: збірник наукових праць. – Вип. 48. – Сімферополь: НАПКС, 2013. – С.24-28.
7. *Бумага А.І.* Точкове рівняння дуги параболи другого порядку/ А.І. Бумага // Прикладна геометрія та інженерна графіка: міжвідомчий науково-технічний збірник. – Вип.90. – К.: КНУБА, 2012. – С. 49-52.