Abstract

The article describes the use of innovative approaches to application of Professor M. D. Kargopolov’s universal matrix formula in the calculation of the cost of construction products, simultaneously determining all products’ cost parameters, taking into account both variable and semi-fixed costs. The technique of calculations by the matrix formula in the calculation of the prime cost of design solutions allows taking into account any changes in the multi-stage value-added chain, taking into account the market factors. Therefore, it is recommended for determining the value of indicators in management accounting of cluster products manufacture. This formula is applicable for the calculation of R and D products cost values, as well as for the determination of contract prices for the implementation of the Federal Law "On the contract system in the area of procurement of goods, works, and services for state and municipal needs". Calculation of the total cost of production with the use of Professor M.D. Kargopolov’s matrix formula was performed on the example of reinforced concrete slabs: From the cost of complex binders for making innovative products concrete composites implemented by FSBEI HPE "Academician M. D. Millionshtchikov GSOTU" to manufacturing slabs based on the actual production costs.

Keywords: Calculation of Cost Indicators of Research and Development Products, Costing of Design Solutions, the Cost of Construction Products, the Matrix Formula of Professor M. D. Kargopolov

1. Introduction

The Civil Code of Russia according to the technical documentation and estimates determining the price of the construction work. According to the current "Technique for determining the cost of construction products in the territory of the Russian Federation MDS 81-35.2004, approved by the Resolution of the State Construction Committee of Russia on 05.03.2004 #15/1", the estimated cost of construction is the sum of money required for the construction according to the project and is the basis for determining capital investments, financing of the construction, formation of contractual prices for construction products, payments for the performance of contractual works (construction and installation, repair and construction, etc.), payment of expenses for the purchase of equipment and its shipment to the construction site, as well as compensation for other costs from the funds provided for by the summary estimate. The current system of pricing and budget normalization in construction includes the estimated state standards and other estimate normative documents.
necessary to determine the estimated cost of construction. The estimated cost of construction and installation works includes: Direct costs, overheads, and profit estimates.

Professor O. V. Didkovskaia believes that “The current price of any kind of products, including construction products, is rather ‘random’, which is dictated by the economic position of the market players..., there is no objective market price,... the market cost-based pricing approach is implemented at the level of each individual unit of (labor, technical, financial) resource. The whole “edifice” of norms and standards is decomposed into elemental pieces, elemental resource indicators (man-hours, machine hours, tons, km, pcs.), each of which has a market substantiation—the formed market price,”... herewith,” The market certainty “is inherent only in its individual cells—types of work, structural elements, finished capital construction of various scale—in the form of cost parameters of similar project, a system of aggregates of design elements, types of works, and utilities”.

Alekseev noted that “Mathematization of economics is the process of introducing mathematical methods in it, a kind of formalization understood in the broadest aspect as separation of the form of a subject from the content” This mathematical formalization of economic science “is performed in the same order: Separation of the formal aspect of economic knowledge from the content aspect; appearance of the first vernacular concepts (labor, interest, etc.), providing communication; mathematization (as a replacement of concepts with symbols; interpretation of logical links between concepts in the language of mathematics).” In the article “Mathematical methods in Economics: Evolution and Prospects”. The authors believe that economic science has not yet developed methods that would lead to sustainable crisis-free management and long-term forecasting of the economic system, and the development of more sophisticated mathematical methods that can adequately describe the processes is only at the initial stage.

In the past, the Soviet economic and mathematical school formed in the 1950-1960s, was represented by the works of Aganbegian, Granberg, Kantorovich, Nemchinov, Novozhilov, Petakov, Pontriagin, Fedorenko, Shatalina and others, who introduced the economic and mathematical models of the game theory, general market equilibrium, economic growth, econometric analysis, cross-sectoral balance, linear and dynamic programming, optimal management, etc.

The approaches of the Nobel Laureate Leontiev to economics, “as a quantitative science, where the methods of quantitative analysis are not merely a methodological tool applied by the researcher, and themselves become the object of study” are of particular importance.

It should be noted that the optimization problems related to the minimization of costs and maximization of the social product in our country were considered in the works of Kantorovich and many other scientists. For example, Mirkin and Faenson noted, “strict mathematical expression of the balance method of planning is obtained in matrix models.” Matrix economic and mathematical models include: 1. The cross-sectoral and inter-district balance of production and distribution of products in the economy; 2. The matrix models of the economy sectors development plans; 3. The cross-sectoral balances of production and distribution of products of the republics and economic regions; 4. The matrix models of annual plans (technical, industrial, and financial plans) of enterprises.

At the current stage, for the calculation of the prime cost and effectiveness of design solutions with account of the market factors, especially in the framework of the mechanism of registration and regulation of the use of budgetary funds, the article examines the possibility of applying the universal matrix formula of Professor M.D. Kargopolov in the construction industry, voiced in the report: “The matrix formula for calculating the production prime cost and unit price for products “Mathematics, Economics, Management: To the 100th Anniversary of L.V. Kantorovich” held at the St. Petersburg State University on 9.02.2012, based on the work “Inter-and cost of production: Theory and Practice”. In the works of M.D. Kargopolov, the example of a paper mill producing sophisticated and simple products was used for the study of the system of economic indicators for planning the current (annual) production and economic activities of enterprises and organizations. Application of the calculations through Professor M.D. Kargopolov’s matrix formula for the calculation of full prime cost in each case allows determining the market value of any desired products, including construction products.

The innovativeness of Professor M.D. Kargopolov’s method is that the inter-op balances allow accounting for not only the variable, but also semi-fixed costs in economic calculations, and inter-op balances between benefit and cost of production are considered as the basis of all subsequent economic calculations in the enterprise.
to ensure subsequent accurate and balanced calculation of all the indicators of industrial and economic activity of the enterprise, 2001; 2012a.

2. Methodology

At the present stage, rather sufficient volume of economic and mathematical methods of economic information processing has been developed, but the process and the speed of implementation of new algorithms and information technologies in the domestic practice of economic calculations are still insufficient. This is why PhD in Economics M.D. Kargopolov8,12 said: “To move it from the dead spot” and to accelerate it, it is necessary throughout all levels of management to begin to test and implement the simplest and most effective algorithms that are recognized by the scientific world and the practice” (Kargopolov8,12, 2012a).

The methods of economic and mathematical modeling should allow determining the economic condition of the enterprises with the prediction of market prices for e Resource and Technological Models (RTM) for each type of design solutions, as well as for a capital construction project as a whole.

In the Soviet period, the planning of enterprise production was provided by applying matrix models of the technical, industrial, and financial plan10 (Tipovaia metodika (1977), which models were a balance vault of products costs and manufacture. Their basis were assumptions based on cross-sectoral balance sheets, but the technical, industrial, and financial plan models did not address to sectors, but contained a production structure, typical of a particular enterprise: Main and auxiliary workshops, manufacturing operations, and the produced by them intermediate (for domestic consumption) and end (commodity) products.

Professor M.D. Kargopolov8,12 in the article “Inter-op balances between benefit and cost of production: Theory and practice” (2001) and others (Kargopolov8, 2001; 2012a), taking into account the works of Kossov “Cross-industry models10” and Leontiev “Cross-sectoral economy15” developed an algorithm for the matrix formula as a universal tool for measuring the unit cost of goods (works, services), where the balance model is considered as a system of equations, each of which expresses the requirements for a balance between the quantity of products produced by individual economic entities and the total demand for this product.

The basic tool of economic calculations were the developed by M. D. Kargopolov8,12 inter-op balances between benefit and cost of production at the enterprise, calculated by the balance sheet methods based on strict relationship between the costs and the output, like between the production and consumption of products, laid down in the Leontiev’s balance sheet methods “Input-Output.” A simple product is understood as a product (work, service), the production of which uses only Primary—Purchased Resources (PR), and a complex product is taken into account as a product (work, service), the production of which uses not only primary but also Own Production Resources (OPR), i.e. various n types of products (works, services) produced by the enterprise (Kargopolov8, 12, 2012a).

Professor M.D. Kargopolov8,12 matrix formula is written as (Kargopolov8,12, 2012a):

$$P = (E - A^T)^{-1} \cdot D^T \cdot C$$

Where:

- $P = ||p_j||_{1 ... n}$ is the desired column vector of the production (total) cost of production per unit of products (Works, Services);
- $E$ is the identity matrix $nxn$;
- $A = ||a_{ij}||$, $i = 1 ... n$, $j = 1 ... n$ —this is the matrix $nxn$ of norms of own production resources consumption;
- $D = ||d_{ij}||$, $i \in LUR$, $j = 1 ... n$ —this is the matrix of norms of consumption of primary resources (L—variable, R—fixed);
- $T$ — is the transposition operator for matrices $A$ and $D$;
- $C = ||c_{ij}||$, $i \in LUR$ —this is the column vector of the wholesale procurement prices for primary resources; hat determines the desired values o the elements of vector $P$ is written as (Kargopolov8,12, 2012a).

= MMULT (MMULT (MINVERSE (E-TRANSPOSE (A))); TRANSPOSE (D)); C)

M.D. Kargopolov8,12 notes that the use of the matrix formula is not confined to the enterprise, because its use is possible in economic calculations at the sectoral and national economic levels, as it is universal and “allows to determine simultaneously with absolute precision the prime cost of production of a unit of n types of products (works, services) of any complexity” (Kargopolov8, 12, 2001; 2012a).
3. Results

In his work, Professor M.D. Kargopolov\textsuperscript{8,12} considered an enterprise that could produce simple and complex products, where a simple product means a product (work, service), in the production of which only the Primary—Purchased Resources (PR) are used, and a complex product in the calculations means a product (work, service), in the production of which not only primary, but also Own Production Resources (OPR) are used, which may be all n types of products (works, services) produced at the enterprise (Kargopolov\textsuperscript{8,12}, 2012a).

In order to apply this matrix formula to calculate the unit production cost, it is necessary to break up the cost items into two groups: items of costs of own production resources and items of costs of primary resources. Primary costs items are divided into variable (of L-type) and fixed (of R-type). The norms of variable resources consumption $d_{ij}$ are independent of the volumes of production, and the norms of fixed costs consumption $d_{ij}$ depend on the volume of production, and therefore they are reduced to the unit of actual (planned) scope of production of products (works, costs).

For the analysis of the cost parameters, we provide below two variants for calculating the prime cost of composite concrete products performed using:

In the First case, an analysis of the calculations of the prime cost of concrete products according to Aliiev\textsuperscript{2,19} using the calculation technique (Rukovodstvo po opredeleniu\textsuperscript{21}) for the manufacture of concrete slabs PK 10-60.12 made of concretes based on complex binders with fillers made of bottom-ash mixtures and fine sands in the warm season with solar heat treatment and the SVITAP coating, compared to the basic version of these slabs produced using heat treatment of the products in steaming pits\textsuperscript{2,19}.

In the Second case, the cost calculations of the above structures were performed by Professor M. D. Kargopolov\textsuperscript{8,12} matrix formula (Kargopolov\textsuperscript{8,14}, 2012a).

In the First and Second cases, the calculation of the total cost of production of concrete slabs using solar casting boxes used the actual data on labor costs and material consumption for the production of concrete floor slabs PK 10-60.12 in the SUE “Argun plant of concrete products and structures” of the Ministry of Agriculture of the Chechen Republic (AZZhBIK) at one-shift operation of the floor slabs production line and daily turnover of casting boxes.

It should be noted that studies of the collective research center “Nanotechnology and Nano materials” of FSBEI HPE ician M. D. Millionshchikov GSOTU” are related to the implementation of concrete composites that significantly reduce the costs for purchasing expensive binders, surfactants, as well as the costs for humid heat treatment of products\textsuperscript{2,12,13,14}.

For Example, in Aliiev\textsuperscript{2, 19}, based on the research of micro- and macrostructure of the cement stone, the rational concrete mixtures were selected. For pilot studies, the milled mixtures of Portland cement and previously shredded bottom-ash mixtures of local TPP or fine sands modified with the active mineral additive “Bio-NM” were used. The complex binders were obtained by mixing the base cement with floured fillers with surfactants added, by co-grinding cement, filler, and surfactant additive. Herewith, the manufacture and use of concrete composites based on complex binders allow simultaneously improving the environment through the use of boiler bottom-ash waste.

Table 1 shows the indicators of frost and water resistance of concrete composites produced based on the cement and complex binders, which indicate the possibility of widespread use of these innovative materials in our country.

The advantages of solar technology application for concrete composites using complex binding\textsuperscript{2, 19}:

- The option involving heat treatment of the concrete composite with saturated steam is excluded;
- The costs for purchasing expensive cement and for thermal energy (steam) are reduced.
- The depreciation allowances for the steam line are reduced.
- The shop costs for the steaming pits maintenance are reduced.

It should be noted that concrete composites also could be widely used for the production of concrete and reinforced concrete structures, and in the dry hot climate of the Far North.

The compositions and the properties of Complex Binders (CB) with different bases are shown in Tables 2-3\textsuperscript{2, 19}.
Table 1. The frost and water resistance of concrete composites hardened in various conditions\textsuperscript{2,19}

| Type of concrete | Weight, kg | Water absorption, % | ΔV, cm\textsuperscript{3} | Frost resistance | Water resistance |
|------------------|------------|---------------------|-----------------------------|------------------|------------------|
|                  | Original | Saturated | By weight | By volume | grade F | grade W |
| A. Solar heat treatment using the SVITAP coating |
| Concrete composite made of complex binders | 2.17 | 2.24 | 3.21 | 6.53 | 0.35 | 300 | 12 |
| Concrete made of Portland cement | 2.02 | 2.14 | 5.90 | 12.32 | 0.95 | 150 | 8 |
| B. Steam curing in the steaming pit |
| Concrete composite made of complex binders | 2.14 | 2.25 | 5.30 | 11.31 | 0.65 | 200 | 10 |
| Concrete made of Portland cement | 2.01 | 2.14 | 6.17 | 12.23 | 0.95 | 100 | 6 |
| C. Solidifying in the moist chamber |
| Concrete composite made of complex binders | 2.15 | 2.21 | 2.70 | 5.91 | 0.30 | 300 | 12 |
| Concrete made of Portland cement | 2.03 | 2.17 | 6.03 | 12.24 | 1.0 | 150 | 8 |
| D. Ageing without treatment |
| Concrete composite made of complex binders | 2.10 | 2.210 | 5.22 | 10.95 | 1.95 | 100 | 8 |
| Concrete made of Portland cement | 1.98 | 2.15 | 11.21 | 22.10 | 2.78 | 50 | 6 |

Table 2. The compositions and properties of complex binders based on bottom-ash mixtures (KVZ)\textsuperscript{2,19}

| Type of the binder | Q-ty of cement, % | Q-ty of filler, % | Q-ty of the Bio-NM additive, % (of the cement weight) |
|-------------------|-------------------|-------------------|-----------------------------------------------------|
| KV 100            | 100               | -                 | 2                                                   |
| KVZ 70            | 70                | 30                | 2                                                   |
| KVZ 50            | 50                | 50                | 2                                                   |
| KVZ 30            | 30                | 70                | 2                                                   |

Table 3. The compositions and properties of complex binders based on fine sands (KVP)\textsuperscript{2,19}

| Type of the binder | Q-ty of cement, % | Q-ty of filler, % | Q-ty of the Bio-NM additive, % (of the cement weight) |
|-------------------|-------------------|-------------------|-----------------------------------------------------|
| KVP 70            | 70                | 30                | 2                                                   |
| KVP 50            | 50                | 50                | 2                                                   |
| KVP 30            | 30                | 70                | 2                                                   |

For the rational compositions of concrete mixtures Table 4, the cost parameters were defined\textsuperscript{2,19}.

Table 4. Compositions of concrete mixtures\textsuperscript{2,19}

| Sq. No. | Type of binder | Consumption of CB (C/MN), kg/m\textsuperscript{3} | Filler consumption kg/m\textsuperscript{3} | Water consumption, kg/m\textsuperscript{3} |
|---------|----------------|-----------------------------------------------|-------------------------------------------|-------------------------------------------|
| 1       | PC100          | 500(500/0)                                   | 1,500                                    | 140                                       |
| 2       | KVZ 70         | 505(354/151)                                 | 1,495                                    | 152                                       |
| 3       | KVZ 50         | 508(254/254)                                 | 1,524                                    | 152                                       |
| 4       | KVZ 30         | 512(154/358)                                 | 1,536                                    | 164                                       |
| 5       | KVP 70         | 510(357/153)                                 | 1,490                                    | 153                                       |
| 6       | KVP 50         | 508(254/254)                                 | 1,492                                    | 162                                       |
| 7       | KVP 30         | 511(153/357)                                 | 1,489                                    | 164                                       |

Cost parameters of concrete mixture components are taken from Table 5\textsuperscript{2,19}.

Table 5. The cost of the components used for the preparation of fine-grained backfilling concrete mixtures and complex binders is provided in the table\textsuperscript{2,19}

| Description | Portland cement | KVZ 50 | Screening dust (SD) | Water cost, rub/kg | KVZ 50 | Screening dust (SD) | Water cost, rub/kg |
|-------------|-----------------|--------|---------------------|-------------------|--------|---------------------|-------------------|
| Cost, rub/kg| 5               | 3.69   | 0.25                | 0.08              | 4.19   | 0.25                | 0.08              |
The cost of the Complex Binder (CB)\textsuperscript{2,19} was taken as the sum of the components of by the following formula:
\[ C_{cb} = C_{pc} C + C_{f} F + C_{a} A. \]
Where \( C_{pc}, C_{f}, \) and \( C_{a} \) is the price for 1 kg of, for example, KVZ50 comprising respectively, the cost of cement, filler, and Bio-NM additive, rub.

\( C, F, \) and \( A \) are respectively, the amount of cement, filler, and Bio-NM additive in CB, kg.

It is particularly noted that the cost of filler \( C_{a} \) includes the cost of its transportation to the plant, its drying and preliminary grinding, carried out in a scientific laboratory of the building faculty of FSBEI HPE, “Academician M.D. Millionshchikov GSOTU,” and subsequent joint grinding with cement and additive, as noted in the article (Aliiev\textsuperscript{2,19}, 2011), which equaled to 1.5 rub/kg.

Thus, the cost of 1 kg of KVZ 50 equaled to\textsuperscript{2,19}:
\[ C_{cb} = 5 \times 0.5 + 1.5 \times 0.5 + 22 \times 0.02 = 3.69 \text{ rubles.} \]

The number of components of the concrete mix for 1 m\(^3\) of the batch and their cost are shown in Tables 6 and 7\textsuperscript{2,19}.

**Table 6. The number of components of the concrete mix in 1 m\(^3\) of the batch**\textsuperscript{2,19}

| \# of compositions | Type of the binder | Material consumption, kg/m\(^3\) |
|-------------------|--------------------|----------------------------------|
|                   |                    | Cement | OD | Water | N | Bio-NM |
| 1                 | KVZ 50             | 254    | 1,524 | 152 | 254 | 15     |
| 2                 | PC500D0            | 508    | 1,524 | 244 | -   | -      |

**Table 7. The cost of 1 m\(^3\) of the concrete mix**\textsuperscript{2,19}

| \# of compositions | Type of the binder | Cement | OD | Water | N | Bio-NM | The cost of 1 m\(^3\) of concrete, rub. |
|-------------------|--------------------|--------|----|-------|---|--------|----------------------------------------|
| 1                 | KVZ 50             | 1,270  | 381| 12    | 381| 330    | 2,374                                  |
| 2                 | PC500D0            | 2,400  | 381| 20    | -  | -      | 2,801                                  |

According to the data of AZZhBIK, the calculation cost of fuel at steaming 1 m\(^3\) of products in steaming pits was defined equal to 600 rub/m\(^3\), and the cost of steam \( C_{steam} \) is estimated; of which 2,19:
- The estimated cost of steam: \( 1.290 \times C_{steam} \) (where 1.290 t/m\(^3\) is the actual steam consumption for steaming slabby products by the method of I.B. Zasedatelev);
- The cost of other forms of energy was determined as: \( 600 - 1.29 \times C_{steam} \)

The price for steam was revised and taken, according to our calculations, equal to 279.4 rub/m\(^3\) (Aliiev\textsuperscript{2,19}) it was specified 230 rubles for 1 ton of steam).

Table 8 provides the cost calculation of production of 1 m\(^3\) of concrete products according to SUE “Argun plant of concrete products and structures” (AZZhBIK, 2011), specified in article\textsuperscript{2,19}.

The economic efficiency of the concrete composites and use of solar energy to accelerate their solidifying in
article\textsuperscript{2, 19} was defined as the difference between the costs incurred reduced to a comparable unit of work—the design solution of manufactured products by the following formula (Rukovodstvo po opredeleniu..., 1981).

\[ E = (Z_1 - Z_2) \times V_2 = [(C_1 + E_1 I_1) - (C_2 + E_2 I_2)] \times V_2 \]

Where \( E \) is the annual economic effect (for one year of operation of new equipment), rub;

\( Z_1 \) and \( Z_2 \) are the costs for one unit of output (1 m\(^3\) of concrete of the product), produced by the base and proposed technologies, rub;

\( C_1 \) and \( C_2 \) are the cost of 1 m\(^3\) of concrete produced by the base and proposed technologies, rub;

\( I_1 \) and \( I_2 \) are the reduced capital investments in the base and solar technologies for 1 m\(^3\) of concrete, rub;

\( V_2 \) is the annual volume of concrete produced by the proposed technology in the planned year;

\( E_p \) is the planned profit of the enterprise.

Further, for the calculation of the cost of concrete products by the matrix formula of Professor M.D. Kargopolov\textsuperscript{8, 14} (2012a; 2012b), we consider this production as a production complex with shops, manufacturing commercial products—concrete floor slabs (concrete slabs).

Therefore, in Table 9, manufacturing shops are listed by the use of products, which allows determining the order of manufacturing products and the use of Own Production Resources (OPR). For each product type, a physical unit is approved, which does not change during the economic calculations.

The composition of the production resources (cost items) by product types and the norms of application rates for concrete products are shown in Table 10, where the rates of consumption of water, electricity for the preparation of technical water and steam are taken with account of the data in Table 6.

Table 11. The composition and wholesale purchase prices of primary resources\textsuperscript{2,11,17,19}

| Primary resources, units | Price, rub/unit |
|--------------------------|----------------|
| 1. River water before being purified, thousand m\(^3\) | 23.65 |
| 2. Filler, t | 1,500 |
| 3. Portland cement, t | 5,000 |
| 4. Fittings, t | 5,000 |
| 5. Screening dust, t | 250 |
| 6. Additive "BIO-NM," t | 22,000 |
| 7. Capital investments in the solar casting boxes, thousand rubles/m\(^3\) | 0.012 |
| 8. Capital investments in the steaming pit, thousand rubles/m\(^3\) | 0.14 |
| 9. Fuel and energy of all kinds, thousand rubles | 1 |
| 10. Labor costs, thousand rubles | 1 |
| 11. Allocations for social needs, thousand rubles | 1 |
| 12. The cost of equipment maintenance, thousand rubles | 1 |
| 13. Shop’s costs, thousand rubles | 1 |
| 14. Works general expenses, thousand rubles | 1 |
| 15. Other expenses, thousand rubles | 1 |

Thus, Tables 9-11 have all the necessary data needed to perform the calculation of the total cost by the matrix formula of Professor M.D. Kargopolov\textsuperscript{8, 14}:

\[ P = (E - A^T)^{-1} \cdot D^T \cdot C \]

In Microsoft Office Excel, the matrix formula that

Table 9. The characteristic of the production structure of the enterprise

| The composition and names of the units (departments, sections, divisions, teams, services, etc.) | Description of products (works, services) (\textit{u.o.p.})\textsuperscript{*} | Trading products (works, services) -Y | Remarks |
|---------------------------------|----------------------------------------|-----------------------------------|---------|
| 1. Steam and water production shop | Water and steam for production, thousand m\(^3\) | Water and steam | For own needs |
| 2. Concrete products shop with steaming pits | Concrete products, m\(^3\) | Concrete products | For comparison, with the solar heat treatment technology |
| 3. Shop producing concrete slabs with solar heat treatment | Concrete products, m\(^3\) | Concrete products | The studied version of the product manufacturing |

\( * \)Remark. Hereinafter, the following designations are used: \textit{u.o.p.} - unit of production.
### Table 10. The composition of the production resources (cost items) by product types and the norms of application rates

| Products (works, services), units | Production resources (cost items), u.o.p. | Norm of the application rate, u.o.p.- / u.o.p*. |
|----------------------------------|-------------------------------------------|-----------------------------------------------|
| 1. Water for production, t       | Water, thousand rubles 0.02365             |                                              |
|                                  | Electric power, thousand rubles 0.0124     |                                              |
|                                  | Wages, thousand rubles 0.01                |                                              |
|                                  | Maintenance costs (127.8% of wages) 0.01278 |                                              |
|                                  | Shop’s costs (25%), thousand rubles 0.0025 |                                              |
|                                  | Allocations for social insurance (34% - 2011), thousand rubles 0.0034 |                                              |
|                                  | Works general expenses (20%), thousand rubles 0.002 |                                              |
|                                  | Other expenses, thousand rubles 0.0137     |                                              |
| 2. Steam for production, t       | Water, t 1                                |                                              |
|                                  | Electric power, thousand rubles 0.0414     |                                              |
|                                  | Wages, thousand rubles 0.025               |                                              |
|                                  | Maintenance costs (127.8% of wages) 0.0395 |                                              |
|                                  | Shop’s costs (25%), thousand rubles 0.00625|                                              |
|                                  | Allocations for social insurance (34% - 2011*), thousand rubles 0.0085 |                                              |
|                                  | Works general expenses (20%), thousand rubles 0.005 |                                              |
|                                  | Other expenses, thousand rubles 0.1355     |                                              |
| 3. Concrete products steam cured in steaming pits, m³ | Concrete, m³ 1 |                                              |
|                                  | Cement, t/thousand rubles 5.0              |                                              |
|                                  | Fittings, t/thousand rubles 0.065/5.0      |                                              |
|                                  | Screening dust, t/thousand rubles 0.25      |                                              |
|                                  | Filler, t/thousand rubles 1.5              |                                              |
|                                  | BioNM, t/thousand rubles 22.0              |                                              |
|                                  | Steam, t 1.29                              |                                              |
|                                  | Capital investments for a pit chamber, thousand rubles 0.14 |                                              |
|                                  | Fuel and energy of all kinds, thousand rubles 0.600 |                                              |
|                                  | Wages (main and extra), thousand rubles 0.2996 (0.332 – 1.29x0.025 – 0.0015) |                                              |
|                                  | Maintenance costs (127.8% of wages) 0.3834 |                                              |
|                                  | Shop’s costs (25%), thousand rubles 0.0749 |                                              |
|                                  | Allocations for social insurance (2010), thousand rubles 0.10186 |                                              |
|                                  | Works general expenses (20%), thousand rubles 0.05992 |                                              |
| 4. Concrete product (solar heat treated), m³ | Concrete, m³ 1 |                                              |
|                                  | Cement, t/thousand rubles 5.0              |                                              |
|                                  | Fittings, t/thousand rubles 0.065/5.0      |                                              |
|                                  | Screening dust, t/thousand rubles 0.25      |                                              |
|                                  | Filler, t/thousand rubles 1.5              |                                              |
|                                  | BioNM, t/thousand rubles 22.0              |                                              |
|                                  | Capital spending for solar casting boxes, thousand rubles 0.012 |                                              |
|                                  | Fuel and electricity, thousand rubles 0.2794 = (0.6 – 1.29x0.24853), where 0.24853 is the estimated price for 1t of steam) |                                              |
|                                  | Wages (main and extra), thousand rubles 0.3439 |                                              |
|                                  | Maintenance costs (127.8% of wages) 0.4395 |                                              |
|                                  | Shop’s costs (25%), thousand rubles 0.897 |                                              |
|                                  | Allocations for social insurance (2011), thousand rubles 0.1169 |                                              |
|                                  | Works general expenses (20%), thousand rubles 0.06878 |                                              |

*Remark. Hereinafter, the following designations are used: u.o.p. - unit of production; u.o.r. - unit of resource.

2011**—for comparison with the example in the work, we left 34% deductions for the period up to 2011**.
Table 1. Matrix A of the norms of application rates of own production resources (30x30)

| KVZ 30 | KVZ 50 | KVZ 70 | KV 100 | KVP 30 | KVP 50 | KVP 70 | KVZ 30 | KVZ 50 | KVZ 70 | KV 100 | Steam | Water |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|-------|
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 1     |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 2     |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 3     |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 4     |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 5     |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 6     |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 7     |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 8     |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 9     |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 1     | 10    |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 11    |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 12    |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 13    |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 14    |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 15    |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 16    |
| 0      | 0      | 0      | 0      | 0      | 1      | 0      | 0      | 0      | 0      | 0      | 1.29  | 0.14  |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 1.29  | 0.152 |
| 0      | 0      | 0      | 0      | 0      | 1      | 0      | 0      | 0      | 0      | 0      | 1.29  | 0.152 |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 1.29  | 0.164 |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 1.29  | 0.164 |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 1.29  | 0.164 |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 1.29  | 0.164 |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 1.29  | 0.164 |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 1.29  |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 0.14  |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 0.152 |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 0.152 |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 0.164 |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 0.164 |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0     | 0.164 |

1.75876  2.14376  2.52601  3.095  1.36782  1.76276  2.17158  1.37476  1.76276  2.15226  2.72  0.24853  0.08043
| KVP 30 | KVP 50 | KVP 70 | KVZ 30 | KVZ 50 | KVZ 70 | KV 100 | KVP 30 | KVP 50 | KVP 70 | KVZ 30 | KVZ 50 | KVZ 70 | KV 100 | KVP 30 | KVP 50 | KVP 70 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |

| 3.42474 | 3.82027 | 4.22787 | 3.44343 | 3.82747 | 4.20972 | 4.77774 | 4.05854 | 4.45407 | 4.86167 | 4.07723 | 4.46127 | 4.84352 | 5.41154 | 1.74007 | 2.13576 | 2.54408 |
Table 14. Matrix D of norms of application rates of primary resources including purchased ones for the production of concrete products (30x30)

| Capital investments in steaming pits, thousand rubles | 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 |
|-------------------------------------------------------|------------------------------------------|
| Cement t                                              | 0.5                                      |
| SD t                                                   | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |
| Filler t                                               | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 |
| BIO-NM t                                               | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 22 |
| El.power + fuel, thousand rubles                       | 0.0124 0.0414 | 0 0.065 0.065 0.065 |
| Fittings t                                             | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 |
| Water, thousand rubles                                 | 0 0.02365 | 0 0.065 0.065 0.065 |
| Wages thousand rubles                                  | 0.00034 0.00038 | 0 0.065 0.065 0.065 |
| Maintenance costs thousand rubles                      | 0.00278 0.00312 | 0 0.065 0.065 0.065 |
| Shop costs 25% thousand rubles                         | 0.0025 0.00025 | 0 0.065 0.065 0.065 |
| main34% thousand rubles                                | 0.00034 0.00038 | 0 0.065 0.065 0.065 |
| WGE20% thousand rubles                                 | 0.00137 0.00085 | 0 0.065 0.065 0.065 |
| Other thousand rubles                                  | 0.0002 0.0005 | 0 0.065 0.065 0.065 |
determines the desired values of the elements of vector P is written as:

\[ P = \text{MMULT} (\text{MMULT} (\text{MINVERSE} (E), \text{TRANSPOSE} (A)); \text{TRANSPOSE} (D)); C) \]

The present example, in Tables 12, 13, the calculated matrices \( A^T \) (30x30) and \( P \), in Table 14—\( D^T \), and in Table 15—\( C \) are built in such a manner as to sequentially reveal the production figures from simple products (Water, Steam) to complex—concrete products with different manufacturing technologies:

- The production of process water (from river) - column 1;
- Steam production - column 2.
- Production of Complex Binders CB (dry mixture: cement, filler, and additive “Bio-NM”) made in the scientific laboratory of the construction faculty of FSBEI HPE “Academician M.D. Millionshchikov GSOTU”\(^{12,19} \) - columns 3–9.
- Production of components of concrete mixes (dry mixture: complex binders—CB and screening dust) - columns 10-16.
- Production of 1 m\(^3\) of concrete products steamed in steaming pits - columns 17–23.
- Production of 1 m\(^3\) of concrete products with solar heat treatment - columns 24–30.

The calculations in matrix \( P \) Table 13 provided all values of full prime costs of 30 types of products, the absolute values of which differ from similar indicators provided\(^{2,19} \) in up to 0.2% due to the increase in the refined estimated cost of steam - 279.4 rubles, instead of 230 rubles for 1 ton of steam\(^{2,19} \).

The purpose to change the technique of calculation with matrices, additional calculation was performed, where the above matrix \( A \) with the dimension of 30x30 was divided into two matrices:
Table 17. Matrix AA of norms of application rates of own production resources and dry mixture for concrete products

| OPR | Compositions of binders | Dry concrete mix | PP |
|-----|-------------------------|------------------|----|
| Water | Steam | KV 100 | KVZ 70 | KVZ 50 | KVZ 30 | KVP 70 | KVP 50 | KVP 30 | KV 100 | KVZ 70 | KVZ 50 | KVZ 30 | KVP 70 | KVP 50 | KVP 30 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| Water | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.08 |
| Steam | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.249 |
| KV 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2.72 |
| KVZ 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2.152 |
| KVZ 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1.763 |
| KVZ 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1.375 |
| KVP 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2.172 |
| KVP 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1.763 |
| KVP 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1.368 |
| KV 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 3.095 |
| KVZ 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.526 |
| KVZ 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.144 |
| KVZ 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.759 |
| KVP 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.544 |
| KVP 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.136 |
| KVP 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.74 |

• AA (dimension 16x16), corresponding to DD, EE.
• AAA (dimension 16x16), corresponding to DDD, EEE.
• That is, the data in Tables 12–15 were respectively converted and presented in Tables 16–25.
• Thus, in matrix AA (16x16) and DD, the data on water and steam (columns 1 and 2), as well as and on the dry components of concrete are provided:
• Complex Binders CB (Dry mixture: Cement, filler, and additive “Bio-NM) - columns 3–9.
• Components of concrete mixes (Dry mixture: Complex binders CB and screening dust) - columns 10–16. Matrices AAA (16x16) and DDD also reflect, respectively, the data on water and steam (columns 1 and 2), as well as production:
• 1 m³ of concrete products steam cured in steaming pits (columns 3–9);
• 1 m³ of concrete products with solar heat treatment (columns 10–16).

For matrices AA and AAA in this example, the identity matrices EE and EEE are the same by dimension and equal to 16x16 Table 21.

Note that in Tables PP and PPP, the full prime costs of the above-mentioned products obtained by calculation through matrices AA with DD and AAA with DDD, respectively, are 100% identical with the previously
Table 19. Matrix DD of norms of application rates of primary resources including purchased ones (dry mixture for concrete products)

|                                | Capital investments in steaming pits, thousand rubles | Capital investments in solar casting boxes, thousand rubles | Cement t | SD t | Filler t | BIO-NM t | El.power + fuel, thousand rubles | Fittings t | River water, thousand rubles | Wages thousand rubles | Maintenance costs thousand rubles | Shop costs 25% thousand rubles | main34% thousand rubles | WGE20% thousand rubles | Other thousand rubles |
|--------------------------------|--------------------------------------------------------|------------------------------------------------------------|----------|------|----------|----------|---------------------------------|------------|-------------------------------|----------------------|----------------------------------|-----------------------------|------------------------|------------------------|------------------------|
|                                | 0                                                      | 0                                                          | 0       | 0    | 0        | 0        | 0.0124                         | 0          | 0.02365                       | 0.01                  | 0.01278                         | 0.0025                  | 0.034                 | 0.002                     | 0.0137                 |
|                                | 0                                                      | 0                                                          | 0.5     | 0.15| 0.354    | 0.254    | 0.154                           | 0.153      | 0.00708                       | 0.00658               | 0.00508                         | 0.00414                 | 0.000708               | 0.00658                 | 0.00508                |
|                                | 0                                                      | 0                                                          | 0.354   | 0.15| 0.358    | 0.254    | 0.154                           | 0.153      | 0.00658                       | 0.00508               | 0.00414                         | 0.000708               | 0.00658               | 0.00508                 | 0.00414                |
|                                | 0                                                      | 0                                                          | 0.254   | 0.15| 0.357    | 0.254    | 0.154                           | 0.153      | 0.00508                       | 0.00414               | 0.000708                         | 0.00658               | 0.00508               | 0.00414                 | 0.000708               |
|                                | 0                                                      | 0                                                          | 0.154   | 0.15| 0.357    | 0.254    | 0.153                           | 1.5        | 0.00414                       | 0.000708             | 0.00658                         | 0.00508               | 0.00414               | 0.000708               | 0.00658               |
|                                | 0                                                      | 0                                                          | 0.153   |     |         |          |                                 | 1.5        | 1.5                           | 1.5                 | 1.5                            | 1.5                     | 1.5                   | 1.5                     | 1.5                   |

*) Matrix EE is similar to matrix EEE with the dimension 16x16
Table 20. Matrix AA of norms of application rates of own production resources and dry mixture for concrete products

| OPR         | Concrete products steamed in steaming pits | Concrete products with solar heat treatment |
|-------------|--------------------------------------------|--------------------------------------------|
| Water       |                                            |                                            |
| Steam       |                                            |                                            |
| Water       | 0.14                                       | 0.08043                                    |
| Steam       | 0.152                                      |                                              |
| KV 100      | 1.29                                       |                                              |
| KVZ 70      | 0.152                                      |                                              |
| KVZ 50      | 0.164                                      |                                              |
| KVZ 30      | 0.162                                      |                                              |
| KVP 70      | 0.153                                      |                                              |
| KVP 50      | 0.162                                      |                                              |
| KVP 30      | 0.164                                      |                                              |

determined total prime cost values in $P$, performed according to the data of matrices A and D.

In the calculations of the prime costs by the matrix formula, the calculation technique allows to obtain the cost indicators also for intermediate types of products, from the value of the complex binders for producing innovative products—concrete composites implemented by FSBEI HPE “Academician M.D. Millionshchikov GSOTU,” to the value of concrete slabs with account of the real production costs.

These changes in the calculation technique that uses the formula of Professor M.D. Kargopolov²⁹ allow performing calculations with any options of changes in the design solutions that take into account the changes in the cost parameters of materials (cement, fittings, components of binders, etc.) and reflect the numerous variants of changes in the construction structures.

4. Discussion

Formation of the estimated cost of construction products is an essential element of economic relations between all participants in the investment and construction complex, taking into account all the conditions and requirements of the modern construction market. However, during the formation of the cost of construction products between participants of the investment process, a number of disagreements occur regarding the procedure and resolution of mutual inconsistencies concerning the price of construction works even with account of the existing legal acts and methodological documents.

Studies of pricing in the construction industry since the early 1990s show that the State Construction Committee of Russia constantly addressed the issues of adaptation of
Table 21. Matrix DDD of the norms of application rates of primary resources including purchased ones for concrete products

| KV 100 | KVZ 70 | KVZ 50 | KVZ 30 | KVP 70 | KVP 50 | KVP 30 |
|--------|--------|--------|--------|--------|--------|--------|
| 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 |
| 3.095 | 2.52601 | 2.14376 | 1.75876 | 2.54408 | 2.13576 | 1.74007 |

Table 25: CCC

| KV 100 | KVZ 70 | KVZ 50 | KVZ 30 | KVP 70 | KVP 50 | KVP 30 |
|--------|--------|--------|--------|--------|--------|--------|
| 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 |
| 0.0124 | 0.02365 | 0.03195 | 0.03395 | 0.05082 | 0.03827 | 0.03365 |

Capital investments in steaming pits, thousand rubles
Capital investments in solar casting boxes, thousand rubles
El.power + fuel, thousand rubles
Fittings t
River water, thousand rubles
Wages thousand rubles
Maintenance costs thousand rubles
Shop costs 25% thousand rubles
main34% thousand rubles
WGE20% thousand rubles
Other thousand rubles
estimate standards of the Soviet period to the market in the circumstances of inflation. However, the collections GESN-2001, FER-2001, FSSC-2001, and FSEM-2001 as amended in 2000–2007 lost their power by the beginning of 2008 in connection with the publication of their new revision by the State Construction Committee of Russia, which in more than 200 official publications made more than 70,000 changes, affecting virtually every line of these collections.

Professor O.V. Didkovskaya repeatedly noted that the issues of pricing in many other sectors of production of goods (works, services) were resolved a bit easier than in the construction industry, as in those sectors, it is possible to calculate the cost based on the influence of supply and demand and determine the appropriate amount of profit, finally getting the price of goods (works, services). As for the construction industry, “There are multiple problems today: The fragmented regulation, the absence of a common terminology base and standardized classifications (nomenclatures) of capital construction projects, irrelevant to modern conditions methodological support of the order of drawing up cost estimating documentation. “But the greatest passions and maximum negativity arise in the relations between customers and contractors in the course of fulfillment of concluded state (municipal) contracts.”

Calculations of the total prime cost of construction products—concrete slabs—by the matrix formula of Professor M. D. Kargopolov allow to calculate several options of cost indicators of products with account of the features of the products manufacture with regard to individual components of the products and the quality of the final product, which is important for the study of cost indicators of products of enterprises on the current market in a competitive environment.

This approach allows to calculate, for example, various cost options of cluster products according to changes in the market prices of components of final products, as well as changes due to the implementation of innovative elements of cluster products (including price changes in the added-value chain, ranging from the cost of production in the scientific center to the finished product in the system of a territorial cluster).

5. Conclusion

- The Matrix formula of Professor M.D. Kargopolov\textsuperscript{8, 14}, as a tool for calculating the prime cost, ensures transparency, accuracy, and efficiency of calculations, which allows recommending it for analyzing and forecasting implementation of innovative products, including in a regional cluster.
- The Matrix formula of Professor M.D. Kargopolov\textsuperscript{8, 14} allows determining various options of the final cost of cluster products in response to changes in market prices for the components, which is important for the activity of the market entities in the circumstances of competition.
- Calculations by the Professor M.D. Kargopolov\textsuperscript{8, 14} matrix formula can be performed with any variants of alteration of design solutions, i.e. changes in the parameters of the scope and cost of materials (cement, fittings, components of binders, etc.) of any market products.
- Modification of the algorithm of cost indicators calculation by the matrix formula is possible and necessary to define the various options of cost indicators of design solutions in construction, especially to account for the added value in the manufacture of individual elements by various enterprises, for example operating as a construction cluster. The performed calculations allow concluding that it is possible to introduce purposeful changes in the technique of calculations by the matrix formula of Professor M. D. Kargopolov\textsuperscript{8, 14}, aimed at defining the indicators of intermediate types of products, which is important for determining the cost parameters (prime cost, total cost), and, if necessary, for calculation of the marketing options of prices with account of the necessary profit.
- For broad implementation of innovative technologies with composite concrete with solar heat treatment, which can help reduce the prime cost of design solutions of in-situ concrete or pre cast concrete products, it is recommended perform a research to obtain data on solar radiation, including the territories of the Far North (during the short but hot summer).
- Calculations by the matrix formula of Professor M.D. Kargopolov\textsuperscript{8, 14} are recommended for calculating cost indicators in conformity with both the requirements of the “Methodology for determining the initial (maximum) price of public contracts for research and development,” and the definition of contract prices at the implementation of the Federal Law “On the contract system in procurement of goods, works, and services for state and municipal needs.”

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