COST EVALUATION OF PRODUCTION IN NEW CONSTRUCTION DEAL RECONSTRUCTION USING SMALL SIZE STRUCTURAL ELEMENTS

Savitsky N.V., Koretskaya S.A., Sherbakova O.V.
Prydniprovs'ka State Academy of Civil Engineering and Architecture,
Dnipropetrovs'k, Ukraine

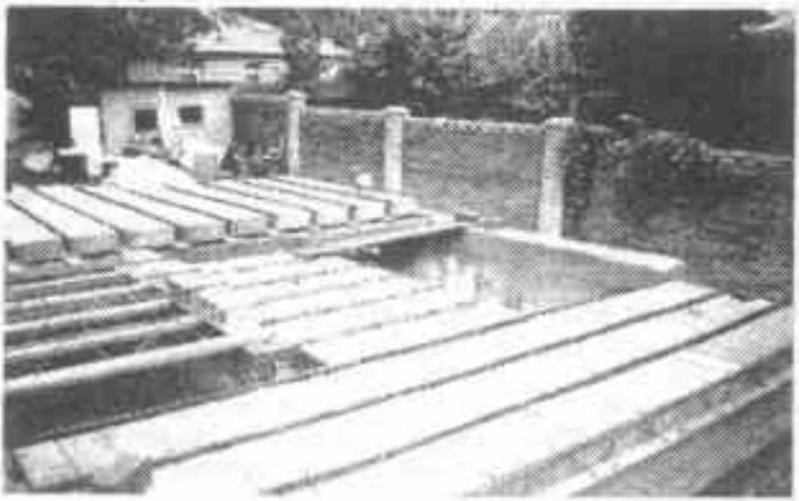
Abstract
The article represents of new constructions from small size structural elements of used in construction and reconstruction. The economic efficiency of reconstruction and construction of buildings with application of new constructions from small size structural elements is defined. Is installed, that at construction of buildings with usage of constructions from small size structural elements the price reduction of cost of structural elements on 3...81 % and "boxes" of a building as a whole in 1,5 times as contrasted to by building from a brick and of ferro-concrete elements. The article made by the special technology on the base of concentrated binding silicate suspension (CBSS) may be attributed to energy efficient materials for new construction and reconstruction of buildings. The represents the methodology of evaluating production competitiveness as a result of some technological innovations introduction after the example of the technology of making tile on the base of concentrated binding silicate suspension. And this progressive technology results in some considerable economic, ecology and operating advantages of the articles over the generally applied technology of making ceramic tile and may be attributed to resource-saving one.

1. Introduction

The modern building complex of Ukraine bases on building industry of modular reinforced concrete. Increasing scales of construction of a new type of housing and reconstruction of buildings of old building need a development of appropriate industrial base of an industry of building materials and constructions. Within the bounds of the state, field, regional and municipal programs the home energy and resource saving architectural constructive technological system (ACTS) of construction and reconstruction using small size structural elements has been worked out by us. Which by introduced concrete materials and ferro-concrete constructions, the nomenclature provides which one a complete set of all building - from the foundation up to a roof. To basic elements of a building treats: the foundations, wall, baffle plate, overlap, roof (tile), architectural details and units, units of an accomplishment. The data's of a materials and construction are characterised by cheapness guaranteed quality, versatility, architectural expressiveness and adaptability to manufacture (fig. 1, fig. 2).
The article made by the special technology on the base of concentrated binding silicate suspension (CBSS) may be attributed to energy efficient materials for new construction and reconstruction of buildings. [1]. Careful learning of the Ukrainian market of building

Figure 1: Reconstruction building from small size structural elements, Dnipropetrovs'k

Figure 2: Construction building from small size structural elements Dnipropetrovs'k



materials displays obviously that ceramic tile corresponding to all the standards for facing materials is used widely in construction. Ceramic tile manufacturing is known to require considerable expenditure of fuel and power resources. As the problem of reducing consumption of them has been urgent in the Ukraine recently, the range of facing ceramic tile should be widened by working out non-baked materials whose physical and mechanical properties and also quality are not lower. Applied at present the non-baked decorating materials on the basis of different kinds of cement containing silicates of calcium are inferior in their physical and mechanical properties to ceramic materials and therefore can not rival them.

2. Economic efficiency of construction and reconstruction of buildings with application of new constructions from small size structural elements

For the substantiation of an economic efficiency of construction and the reconstruction with application ACTS were calculated technological metrics of main structural elements of buildings - walls and overlaps, and also buildings as a whole [2].

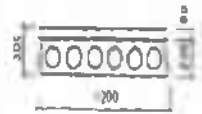
Constructive systems of a building from small size structural elements on 3...58 % more cheaply as contrasted to by brick building (tab. 1).

Cost of the device of overlaps on the system ACTS in 1,84 times is less as contrasted to by overlaps from round-cavitated of slabs, not looking that the complexity of their exponentiation in 1,5 times is higher (tab. 2). The saving is achieved at the expense of lowering expenditures on materials and maintenance of machine and mechanisms.

Table 1: Relative value elements low building

Structural element building	Building from a brick and of ferro-concrete elements	Building ACTS from small size structural elements	Relative value
Foundation	Foundation blocs	Hollow walls stones from heavy-weight concrete	1,58
Outside walls (interior walls and partitions)	Silicate brick, covering claydite gravel, ceramic brick	Stone facing, air space (δ=20mm), hollow wall stone	1,57
Covering	Overlaps from round-cavitated of slabs	Ferro-concrete tee-beams and stones bush	1,42
Stairs	Ferro-concrete steps type - setting	Ferro-concrete G section	1,30
Roof	Cement-sandy till by wooden furring	Cement-sandy till by ferro-concrete frames and wooden furring	1,03
"Boxes" of a building as a whole			1,50

Table 2. Technicoeconomic indices of structural elements of overlaps

Appellation	Sketch	Unit of measure	Quantity elements			Relative value				Labour expense, man-hour
			slabs	tee-beams	stonc bush	altogether	basic wage	exploit a-tion machin e / including wages	material resources	including wages
Overlaps from round-cavitated of slabs		1,2 x 6 = 7,2 m²	1	-	-	1,84	0,046	0,044 / 0,015	1,75	3,61 / 0,08
Overlaps from small size structural elements, stone bush by tee-beams		1,2 x 6 = 7,2 m²	-	2	6 0	1	0,06	0,013 / 0,006	0,92	5,41 / 0,12

In table 1 for unit assumption of value structural element and "boxes" of a building ACTS from small size structural elements.
On data's of researches the accounts of efficiency of reconstruction of buildings of the maiden mass series with application of the system ACTS. In tab. 3 are conducted the relative value of structural elements and deckhouse as a whole, fulfilled in traditional variant and with application ACTS is indicated.
Table 3: Relative value elements superstructure

Structural element superstructure building	Superstructure from brick and round-cavitated of slabs overlaps	Superstructure ACTS from small size structural elements	Relative value
Outside walls	Silicate brick and thermo-insulation from foam-concrete	Facing stones, walls stones, thermo-insulation from foam-concrete	1,33
Covering	Overlaps from round-cavitated of slabs	Ferro-concrete tee-beams and stones bush	1,81
Roof	Cement-sandy till by wooden furring	Cement-sandy till by ferro-concrete frames and wooden furring	1,27
Superstructure of a building as a whole			1,49

In table 3 for unit assumption of value structural element and superstructure of a building ACTS from small size structural elements.

3. General provisions production of materials on the base of concentrated binding silicate suspension

The articles on CBSS may be attributed to non-baked ones. CBSS are highly concentrated mineral water dispersion obtained mainly through wet pounding of some natural silica and aluminium silicate materials. The binding properties of CBSS are stipulated by a content in them of colloidal fraction particles, silicic acid and pH liquid phase. As the main raw material for making decorating tile on CBSS the waste of concentrating raw kaolin-silicate sand (SiO_2 = 93...96%), 2) metallic manganese production scrubbing dust (MMPSD) and 3) glass breakage.

3.1 Technology production of materials on the base of concentrated binding silicate suspension

1) Making the concentrated binding silicate suspension (CBSS). Dosage of sand, glass breakage, MMPSD and water is effected in the plant batcher. The grinding of components the plants ball mill up to the residue in sieve №0063 is not more than

5%. Stabilization of CBSS is effected in stabilizer (the plant-rotating drum). Making CBSS ρ=1,7...1,8 kg/l. pH=10...11 is regulated through adding liquid sodium glass 0,05% of initial raw materials loaded mass in number. Water-solid factor is 0,3...0,4. The reserve of materials at the mill should be not less than for 2 working hours.

2) Marking moulding mass. Dosage of CBSS, filling sands and water is effected in the plant batcher. The mixing of components is done in the mixer. Duration of the mixing is not shorter than 10 minutes.

3) Moulding of articles. Dosage of moulding mass is effected in the plant batcher. Loading the mass is effected into the matrixes of a press. The pressing of the article should be done under pressure of 40 MPa.

4) Heat treatment of the articles. Moulded tile is stowed on the shelves in the chamber desiccator. The schedule of the heat treatment in the desiccator is as follows:

- raising the temperature up to 573 K -1 h,
- isothermal keeping under 573 K – 1 h,
- raising the temperature up to 823 K – 1 h,
- isothermal keeping under 823 K – 2 h.

3.2 Economic efficiency of production facing tile on the base of concentrated binding silicate suspension

Comparison of this non-baking technology with traditional baking one exposes its advantages such as: essentially (3 times) shorter duration of the production cycle, much (about twice) fewer capital expenses for setting up equal production powers, reduction of production squares.

Summing up, it may be said that the technology of marking facing tile on CBSS compared with that of making ceramic tile enables to reduce expenses in the structure of prime cost in the following items of calculation:

- main and additional materials – by 50% (from 36% to 18%) at the expense of excluding expensive white baked kinds of fire-clay and using production waste;
- fuel – by 80% (from 8,2% to 1,7%) - at the expense of excluding from the technology the desiccating of clay and its baking;
- equipment maintaining and operating costs – by 50% (from 20% to 10%) at the expense of excluding from the technology the dispersing desiccator and baking furnaces;
- spoilage loss - by 50% (from 2,8% to 1,4%) at the expense of excluding from the technology the baking process.

As a result the complete prime cost of 1 m^2 of facing tile on CBSS is 35,9% fewer than the complete prime cost of the ceramic tile taken as the basic variant.

In its quality the tile on CBSS is not worse than the ceramic one and even excels it by physical and mechanic properties (see tab. 4).

3.3. Definition of competitiveness facing tile on the base of concentrated binding silicate suspension

The defining the competitiveness of the materials on CBSS let us consider the methodology of defining competitiveness of products after introduction of a technological innovation [3].

Therefore, for evaluation of competitiveness let us make up some parameters of the article under analysis (tile on CBSS) and the rivalling goods (ceramic tile) and compare the obtained result. As these parameters let us consider technical and economic ones. For this purpose let us calculate some single, group and integral indices of products competitiveness (tab. 4).

Table 4: Some single and group indices of competitiveness of facing tile

Index	Tile on CBSS	Ceramic tile	q_i	a_i	G
Technical parameters					
Slump, %	0,075	2	0,037	0,011	0,00041
Water-absorption, %	8,4	9	0,933	0,27	0,25191
Bending strength, MPa	13	12	1,083	0,314	0,34006
Frost resistance, cycle	35	25	1,4	0,405	0,567
					1,12657
Economic parameters (items of prime cost)					
Main and additional materials, %	18	36	0,5	0,0745	0,03725
Fuel, %	1,7	8,2	0,21	0,0315	0,00662
Spoilage loss, %	1,4	2,8	0,5	0,0745	0,03725
Equipment maintaining and operating costs, %	10	20	0,5	0,0745	0,03725
Electric energy, %	4,1	4,1	1,0	0,149	0,149
Wages with deductions, %	12	12	1,0	0,149	0,149
Shop and plant expenses, %	12	12	1,0	0,149	0,149
Non-production expenses, %	3,9	3,9	1,0	0,149	0,149
Others, %	1	1	1,0	0,149	0,149
					0,86337

Single indices expose the percent correlation between a technical or economic parameter and the value of the same parameter of the rivalling goods:

$$q = \frac{P}{P_{100}} \times 100,$$

here q – single parameter index;

P – the level of parameter of the article under research;

P_{100} – the level of parameter of the article taken as a sample and covering 100% of requirement.

Group index (G) combines single indices (q_i) of homogeneous group of parameters (technical, economic, aesthetic) by means of weight coefficients (a_i) obtained empirically:

$$G = \sum a_i \times q_i .$$

Integral index (J) is the correlation of technical parameters group index (G_m) and economic parameters group index $(G_э)$:

$$J = G_m / G_э.$$

If $J<1$ it means that the article under analysis is inferior to the sample, and if $J>1$, it excels the article taken as the sample by its parameters.

Resulting all above we may say that the tile on CBSS under evaluation by its technical and economic parameters excels ceramic tile and is competitive:

$$J = 1,12657/0,86337 = 1,305.$$

Conclusion

1. As a result of conducted accounts is installed, that cost of the device of overlaps on the system ACTS in 1,84 times is less as contrasted to by overlaps from round-cavitated of slabs, not looking that the complexity of their exponentiation in 1,5 times is higher. The saving is achieved at the expense of lowering expenditures on materials and maintenance of machine and mechanisms. Constructive systems of a building from small size structural elements on 3…58 % more cheaply as contrasted to by brick building.
2. The article made by the special technology on the base of concentrated binding silicate suspension (CBSS) may be attributed to energy efficient materials for new construction and reconstruction of buildings. Therefore the analysis of the technology CBSS and materials on their basis from economic, ecological and operating point of view displays some important advantages over the traditional technology of manufacturing ceramic materials. It enables to attribute this technology to resource-saving one, and products on CBSS are competitive in the Ukrainian market.

References

1. Суміш для виготовлення облицювальних виробів/Шпирько М.В., Корецька С.О.//Декл. патент України на винахід № 42439 А, С04В35/00, 22.02.2001 р.
2. Залізобетонний каркас малоповерхової будівлі/Савицький М.В., Шляхов К.В., Большаков В.І., Швець М.А., Переславець С.А., Рутштейн В.М.//Декл. патент на винахід №36627 А, 6 Е04G23/00,. 16.04.2001. Бюл. №3.
3. Савицкая Г.В. Анализ хозяйственной деятельности предприятия: Учеб. пособие. –Мн.: Новое знание, 2001.–704 с.