ТЕХНОЛОГІЯ ТА ОРГАНІЗАЦІЯ БУДІВЕЛЬНОГО ВИРОБНИЦТВА

УДК 624

FLOORING OPTIONS FOR OFFICE SPACES

ВАРІАНТ ПІДЛОГ ДЛЯ ОФІСНИХ ПРИМІЩЕННЬ

Babich Ye.Ye., Candidate of technical sciences, associate professor, Homon P.S., candidate of technical sciences, associate professor, Polianovska O. Ye., Prokhoniuk L. candidate of technical sciences, Prokopets T., student, (National University of Water and Environmental Engineering, Rivne)

Бабіч Є. Є., к.т.н., доцент, Гомон П. С., к.т.н., доцент, Поляновська О. Є., к.т.н., доцент, Прокопець Т., студентка, (Національний університет водного господарства та природокористування, м. Рівне)

The optimal flooring option for commercial premises was selected.
The following flooring options for offices were considered: flooring made of ordinary ceramic tiles; flooring using parquet; laminate; concrete covering. All the work required to install flooring on a rough screed was considered. An analysis of materials was carried out.
The cost of materials per 1 m2 of floor space and capital investments for construction work were calculated.
Annual operating costs for floor repair and restoration were determined. The discounted costs were calculated, and conclusions and justifications for the selection of options for further design were made.

Ключові слова. підлога з звичайної керамічної плитки; підлога з використанням паркету; ламінат; бетонне покриття, вартість матеріалів, розрахунок капітальних вкладень, річні експлуатаційні витрати, кошторисна собівартість, приведені витрати.
flooring made of ordinary ceramic tiles; flooring using parquet; laminate; concrete covering, cost of materials, calculation of capital investments, annual operating costs, estimated cost, reduced costs.

Commercial premises require a certain look that reflects what is happening inside the building. The flooring creates the aesthetics of the office, provides the necessary functionality and significantly increases the level of comfort.

Flooring made of ordinary ceramic tiles is often used. It lasts a long time and does not wear out. Tiles are water-resistant, stain-resistant, and enhance the beauty of the office.

Floors using wood parquet have always looked stylish in most offices and have never gone out of fashion. This type of flooring enhances the appearance of office interior design and is also durable.

Laminate flooring is popular for commercial flooring. It is ideal for a wide range of applications in offices, commercial, medical and retail premises that need to withstand heavy traffic. This type of flooring is damage resistant, easy to maintain, durable and environmentally friendly.

Concrete is indeed a very durable building material. Concrete floors can easily withstand all foot traffic and the movement of furniture and equipment.

The floor is the element that primarily bears the brunt of busy office life. However, most companies are very price-sensitive. Let's consider how to choose a floor covering that combines visual appeal with economic feasibility.

For comparison, four types of flooring were considered:

1) flooring made of ordinary ceramic tiles;
2) flooring using parquet;
3) laminate;
4) concrete covering.

1. Analysis of materials for comparing the cost of installing flooring

For each flooring option, it is necessary to include all the work required to install the floor on a rough screed. This work includes waterproofing the floor, installing a levelling screed, installing various types of underlayment, and finishing the surface itself. After that, the specific type of flooring is installed. Therefore, the variation and impact of these indicators on the initial cost of the floor varies. At the same time, the floors themselves have different service lives, which significantly affects the costs associated with these floors. Let's determine which materials we will use in one or another flooring option.

There is a huge variety of manufacturers and ceramic tiles on the Ukrainian market. Builders can choose from a wide range of interior designs. Prices for ceramic tiles in Ukraine currently range from 250 to 1,000 UAH per square metre and above. Adhesive mixtures are a significant component of the cost of installing ceramic flooring. The price for 25 kg of adhesive mixture varies depending on its purpose, frost resistance and plasticity, and ranges from 98 to 500 UAH.

The price of natural parquet ranges from 600 to 1,000 UAH. The price of artificial parquet ranges from 300 to 1,000 UAH. There is also parquet flooring on the market that has a simplified installation system. The price of parquet flooring varies from 800 to 1,200 UAH.

Foreign manufacturers dominate the Ukrainian laminate market. The price of laminate varies between 360 and 800 UAH. The main advantage of laminate flooring is its ease of installation. However, laminate flooring requires an underlay, of which there are currently many variations.

To make a mosaic floor, all you need is a coloured mixture and filler.

2. Calculation of material costs per 1 m^2 of floor space

Table 1

Cost of materials per 1 m2 of flooring.

Flooringз	price per 1 m2 of flooring, UAH			
	materials	minimum	maximum	average
ceramic tiles	ceramic tiles, UAH/m2	260	1000	350
	adhesive mixture, UAH/kg	98	300	190
parquet	parquet boards, UAH/m2	600	950	700
laminate	laminate, UAH/m2	360	800	430
	underlay, UAH/m2	27	182	52
mosaic	mixtures for mosaic floors, UAH/m2	204,0	326,0	244, 0

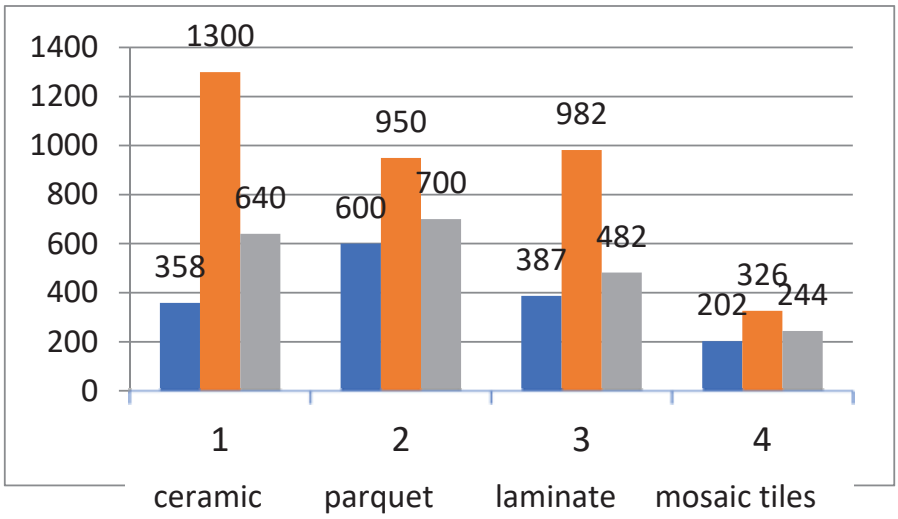

Figure 1. Cost of materials per 1 m^2 of flooring installation (minimum, maximum and average)

The cheapest flooring option is mosaic flooring. Parquet and laminate flooring are less expensive. Ceramic tile flooring is the most expensive option. However, in practice, you also need to consider the cost of installing the flooring, the cost of additional materials, as well as their service life and operating costs. Therefore, the next step is to determine the cost of construction and installation work for such flooring, as well as to determine the reduced costs, which include operating and repair costs and capital investments in the base.

3. Estimated cost of flooring installation

The cost of flooring installation work is determined as the sum of direct and indirect costs.

$$C_{ci} = \mathrm{B}_{dir.cost} + \mathrm{B}_{indir.cost} \quad (1)$$

$$\mathrm{B}_{dir.cost} = W^c + F + M \quad (2)$$

$$\mathrm{B}_{indir.cost} = G \quad (3)$$

де $\mathrm{B}_{dir.cost}$ - direct costs;
$\mathrm{B}_{indir.cost}$ - indirect costs;
W^c- construction workers' wages;
F - cost of operating machinery and equipment;

M - estimated cost of materials and structures,

G - general production costs.

We determine the cost of installing the floor according to [1...4] in the form of a local estimate per 1 m2 of floor, as in the previously used sequence [5, 6].

4. Calculation of capital investments in the base

Capital investments in the construction base are determined by the expression:

$$К_b = К_{cm} + К_t + К_{mech}; \quad (4)$$

де $К_b$ – capital investments in the construction base, UAH;

$К_{cm}$ – capital investments in the production of construction materials and components, UAH;

$К_t$ – capital investments for the purchase of transport vehicles, UAH;

$К_{mech}$ – capital investments for the purchase of machinery and mechanisms required for performing construction works, UAH.

Capital investments for the purchase of materials for flooring are equal to:

$$K_{m.}=V_{sm}, \quad (5)$$

V_{sm}– elling price of construction materials according to the resource code, UAH.

The cost of flooring materials:

ceramic tiles $V_{sm} = 292712$ UAH., parquet: $V_{sm} = 544293$ UAH.,

laminate: $V_{sm} = 314593$ UAH., mosaic: $V_{sm} = 98779$ UAH.

Capital investments for the acquisition of transport vehicles used for transporting structures, products, and materials from the supplier to the construction site are determined by the following expression:

$$К_t = (C_b \cdot t_{req})/t_n \quad (6)$$

C_b – balance value of transport vehicles, UAH.;

t_{req} – equired operating time of transport vehicles at the construction site, machine-hours;

t_n = 3000 machine-hours — normative annual operating time of transport vehicles.

The time required for vehicles to transport goods from the supplier to the construction site is determined by the expression:

$$t_{req} = (\mathrm{P} \cdot L)/(Q \cdot V \cdot K_{\mathrm{load}}) \quad (7)$$

t_{req}— required transport time,

P — total cargo to be transported,

L — transport distance,

Q — vehicle carrying capacity,

V — average vehicle speed,

K_{load} — load utilization coefficient.

Time required for vehicles to transport flooring materials:

ceramic tiles: $\mathrm{t_{req}} = (12 \cdot 12)/(5 \cdot 60 \cdot 1) = 0{,}48$ machine − hours.

parquet: $\mathrm{t_{req}} = (4{,}6 \cdot 12)/(5 \cdot 60 \cdot 1) = 0{,}184$ machine − hours.

laminate: $\mathrm{t_{req}} = (3{,}6 \cdot 12)/(5 \cdot 60 \cdot 1) = 0{,}144$ machine − hours.

mosaic: $\mathrm{t_{req}} = (36 \cdot 12)/(8 \cdot 60 \cdot 1) = 0{,}9$ machine − hours.

The balance sheet value of a vehicle used for transporting structures is determined by the expression:

$$C = C_b \bullet K_{tm} \quad (8)$$

C - balance sheet value of the vehicle;

C_b — base (catalog or selling) price of the vehicle according to the manufacturer's price list;

K_{tm} =1.07 — coefficient accounting for the costs of delivery and installation of the vehicle from the manufacturing plant to the construction site.

The balance sheet value of the vehicle for transporting all insulation materials is:

$$C=820000 \cdot 1,07=877400 \text{ UAH.}$$

Then, capital investments for the purchase of vehicles for transporting flooring materials:

ceramic tiles: K_{veh}= (2877400·0,48)/3000=461 UAH

parquet: K_{veh}= (2877400·0,184)/3000=177 UAH

laminate: K_{veh}= (2877400·0,144)/3000=138 UAH

mosaic: K_{veh}= (6270400·0,9)/3000=1881 UAH

Capital investments in the floor base:

ceramic tiles: $K_{base} = 292712 + 461 = 293173$ UAH;

parquet: $K_{base} = 544293 + 177 = 544470$ UAH;

laminate: $K_{base} = 314593 + 138 = 314731$ UAH;

mosaic: $K_{base} = 98779 + 1881 = 100660$ UAH.

5. Determination of annual operating costs

Annual operating costs for floor repair and restoration are determined by the expression:

$$E_r = \frac{C_{ci}}{T_s} + \frac{C_{ci} \cdot (\%)}{100} \quad (9)$$

де, E_r – annual operating costs for repair and restoration of the floor structures, UAH;

C_{ci} - estimated cost of construction and installation works, UAH;

T_s – service life (operating period), years

(%) – percentage rate accounting for additional annual repair and maintenance expenses.

Annual operating costs for floor repair and restoration:

ceramic tiles: $Er = \left({}^{425921}/_{30}\right) + \left({}^{425921 \cdot 0,07}/_{100}\right) = 14496$ UAH.

parquet: $Er = \left({}^{642442}/_{20}\right) + \left({}^{642442 \cdot 3,5}/_{100}\right) = 54608$ UAH.

laminate: $E_r = \left({}^{383106}/_{5}\right) + \left({}^{383106 \cdot 0,1}/_{100}\right) = 38694$ UAH.

mosaic: $Er = \left({}^{447089}/_{50}\right) + \left({}^{447089 \cdot 0,05}/_{100}\right) = 9165$ UAH.

6. Calculation of reduced costs

Technical and economic assessment of structural solutions for civil buildings and structures is carried out based on the costs provided.

The costs are determined based on [4] using the following formula:

$$C_{red} = [C_{ic} + \text{E}_n \cdot \text{К}_{base}] \cdot \beta + {}^{\text{E}_r}/_{\xi_{red}} \quad (10)$$

де C_{red} – **reduced (brought) costs,** UAH;

C_{ic} - estimated cost of construction and installation works, UAH

E_n = 0,15 - normative efficiency coefficient of capital investments;

К_{base} – **capital investments in the floor base**, UAH;

β – **coefficient accounting for additional factors** (regional or overhead adjustments);

E_r – **annual operating costs for repair and restoration**, UAH;

ξ_{red} = 0,08 - discount (reduction) coefficient.

The costs of installing the floor are as follows:

ceramic tiles: $C_{red} = [425921 + 0{,}15 \cdot 293173] \cdot 0{,}021 + {}^{14496}/_{0{,}08} =$ 191062 UAH.,

parquet: $C_{red} = [642442 + 0{,}15 \cdot 544470] \cdot 0{,}021 + {}^{54608}/_{0{,}08} =$ 697801 UAH.

laminate: $C_{red} = [383106 + 0{,}15 \cdot 314731] \cdot 0{,}021 + {}^{492708}/_{0{,}08} =$ 492708 UAH.

mosaic: $C_{red} = [447089 + 0{,}15 \cdot 100660] \cdot 0{,}021 + {}^{9165}/_{0{,}08} =$ 124273 UAH.

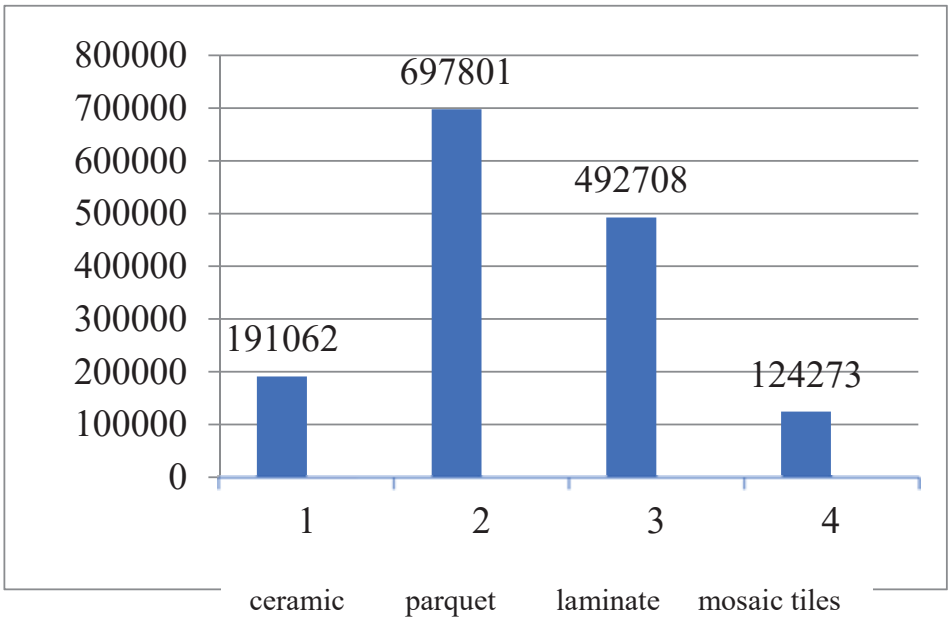

Figure 2. Estimated costs for floor installation

7. Conclusion and justification of the choice of options for further design

Based on a technical and economic assessment for further engineering and technical calculations, we select the optimal design option with the lowest reduced costs.

According to the calculations, the reduced costs for installing the floor are lowest when using mosaic flooring and amount to 124,273 UAH. In second place is ceramic tile, with a reduced cost of UAH 191,062. Therefore, the effective use of mosaic and ceramic tile flooring can be considered.

1. State Building Standards of Ukraine DBN D. 1. 1 – 1 - 2000 (including amendments and additions). Rules for determining the cost of construction. Pricing in construction. Collection of official documents and explanations. Ministry of Construction of Ukraine. No. 1, January 2006. K. "Inproekt".

2. Pricing in construction. Collection of official documents and explanations. Ministry of Construction of Ukraine. No. 2, February 2006. K. "Inproekt".

3. Appendices to DBN D. 1. 1 – 1 - 2000 (including amendments and additions). Rules for determining the cost of construction. Pricing in construction. Collection of official documents and explanations. Ministry of Construction of Ukraine. No. 1, No. 2 2006. K. 'Inproekt'.

4. DSTU B D.2.2-11:2012 Resource element cost estimates for construction works. Floors (Collection 11).

5. Choosing the optimal flooring option for a residential building with commercial premises. Babich E.E., Gomon P.S., Polianovska O.E., Shevchuk M.T. Resource-efficient materials, structures, buildings and structures: Collection of scientific works. Rivne: NUVGP, 2023. Issue 44. P. 275-283.

6. The optimal option for insulating walls with facade insulation. Babich E.E., Gomon P.S., Polianovska O.E. Resource-saving materials, structures, buildings and structures: Collection of scientific works. Rivne: NUVGP, 2024. Issue 45. Pp. 378-385.