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STUDY OF THE TECHNOLOGICAL AND TECHNICAL-ECONOMIC EFFICIENCY OF MECHANIZED DECORATIVE FINISHING WORKS

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Abstract: Decorative finishing works in construction are characterized by high labor intensity, since a considerable part of the process consists of successive operations such as surface preparation, priming, formation of the base layer, application of the decorative composition, texture formation, and final finishing. In this article, the methodology for studying mechanized gypsum plastering by means of time-and-motion observations is retained in substance and adapted to decorative plastering works. A finished surface area of 100 m² was adopted as the unit of investigation, and labor input, work duration, and productivity were analyzed for individual operations. According to the actual calculation presented in a published technological chart for decorative facade plaster coatings, the total labor input is 77.4 man-hours per 100 m², while the work duration is 49.65 hours. Mechanization, flow-line organization of work, and the use of high-performance tools are assessed as the principal factors for reducing labor input and improving the stability of finishing quality.

Keywords: decorative finishing, decorative plaster, mechanization, time-and-motion study, labor input, technological efficiency, technical-economic indicator, facade.

INTRODUCTION. The demand for decorative finishing coatings in modern residential and public buildings is increasing. Decorative plaster not only provides an aesthetic appearance to a surface but also protects the structure from environmental effects. However, the share of manual operations in the execution of such coatings remains considerable. Scientific literature reports that manual operations in plastering may account for up to 60% in certain cases; mechanization can reduce labor input and increase productivity. In the reference study on mechanized gypsum plastering, the process was divided into fixation points, the works were timed, and operational time, preparatory and final time, and rest allowances were determined. In the present article, the same scientific logic is retained, while the object of investigation is replaced by a decorative finishing coating. Decorative finishing works play an important role not only in the architectural expressiveness of buildings and structures, but also in the service stability, hygienic properties, and durability of structural surfaces. Since these works are carried out at the final stages of the construction cycle, geometric deviations from preceding processes, disturbances in moisture conditions, delayed preparation of the work front, and interruptions in material supply become concentrated at the finishing stage. Consequently, the duration of finishing processes is determined not only by worker productivity but also by the organizational and technological condition of the entire construction system [1]. In contemporary construction practice, the range of finishing materials is rapidly expanding, mechanized methods are being introduced, and digital planning tools are developing. Nevertheless, technology selection often prioritizes a single criterion—cost, speed, or material consumption. Such an approach does not fully account for the relationship among quality, labor intensity, the probability of rework, and technological interruptions. Therefore, modeling decorative finishing processes as a multi-criteria system is scientifically relevant. The study is aimed at systematizing the regularities that determine the technological efficiency of decorative finishing works, identifying criteria for assessing modern

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technologies, and proposing a theoretical model for optimizing labor input and construction duration under quality constraints. The methodological basis includes systems analysis, technological decomposition, time-and-motion observations, factor analysis, expert assessment, regression modeling, and multi-criteria optimization. The technological process is divided into elementary operations, and resource, time, quality, and potential loss parameters are recorded for each operation [1].

MAIN PART. The modern development of decorative finishing technologies is observed in three principal directions: control of the functional properties of materials, mechanization of operations, and digitalization of the process. In dry construction mixtures, the coordinated use of mineral binders, dispersed polymers, rheological modifiers, and microfillers reduces dependence on random on-site batching. This is important for ensuring reproducible properties of the applied layer.

The labor input of technological operations involved in decorative plaster coatings is determined in order to rationally organize the work process, assess mechanization opportunities, and analyze efficiency using actual technical-economic indicators for 100 m² of finished surface. Before the time-and-motion study, the decorative finishing process is divided into individual elements, and the start and end fixation points of each element are established. Time expenditure is recorded directly at the workplace. Observation results are analyzed to ensure rational execution of operations, identify unnecessary movements and idle time, and optimize the technological sequence [2–3].

Table 1

No.	Technological operation	Description
1	Surface preparation	Removal of dust, dirt, loose layers, and mortar runs.
2	Surface inspection and beacon installation	Control of geometric flatness and, where necessary, installation of screed guides/beacons.
3	Spatter coat	Application of a bonding coat to improve adhesion between the substrate and the subsequent layer.
4	Primer/base layer	Application of the main leveling layer.
5	Leveling of the base layer	Leveling with a straightedge and finishing tools.
6	Application of the decorative coating layer	Application of a mineral/polymer decorative composition at the specified thickness.
7	Texture formation and final rubbing	Formation of texture using a float, spatula, or texturing tool.

In the technology adapted to decorative finishing, the operations of applying the mixture, leveling it, and forming the final surface are performed according to the same organizational sequence.





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Figure 1. Application of a decorative plaster mixture to a wall surface



Figure 2. Mechanized application of a decorative plaster mixture to a wall surface

In the publicly available technological chart for decorative binder-based facade plaster coatings, the unit of finished product is taken as 100 m². According to its calculation, the total labor input is 77.4 man-hours, while the work duration according to the schedule is 49.65 hours. Table 2 presents the operational indicators from this source [4–5].

Table 2

No.	Process	Unit	Labor input, man-hours
1	Surface preparation for plastering	100 m²	16.0
2	Surface inspection and installation of beacons	100 m²	12.0
3	Application of spatter coat	100 m²	5.5
4	Application of primer/base layer	100 m²	18.5
5	Leveling of the base layer	100 m²	11.0
6	Application of the final decorative coating layer	100 m²	3.4
7	Surface rubbing / texture formation	100 m²	11.0
	TOTAL	100 m²	77.4

Work duration: 49.65 hours per 100 m².

To assess the economic effect of mechanization, other experimental studies of finishing and plastering works were also considered. According to the calculation presented by Gumerova, Gamayunova, and Gorshkov, the mechanized method reduced the work duration from 34.71 working days to 23.22 working days; the authors assessed this as an approximately 33% saving in time. The total cost also decreased from USD 171,753 to USD 147,691 at the prices used in the source study. These values are not direct standards for decorative coatings; rather, they constitute comparative scientific evidence of the influence of mechanization on finishing processes.

Indicator	Manual method	Mechanized method
Work duration, working days	34.71	23.22
Total cost, USD (as calculated in the source)	171,753	147,691

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Result in terms of duration	—	≈33% reduction

Rational Organization of Labor

1) Prepare the work zone in advance: complete preceding processes and rationally arrange equipment, inventory, and materials at the workplace.

2) Ensure continuous replenishment of material stocks and minimize idle time of mechanized equipment.

3) Organize work and rest regimes in a manner that maintains stable working capacity.

4) Form the crew composition in accordance with the work volume and labor intensity of the operations.

5) Minimize unregulated interruptions caused by an unprepared work front, delayed material delivery, equipment failure, power interruptions, and rework of defects.

6) Coordinate technological interruptions and the open working time of the material with the crew rhythm in order to ensure uniform color, texture, and thickness of the decorative layer.

In decorative plastering technology, the greatest labor inputs are associated with surface preparation (16.0 man-hours), setting out and installation of screed guides/beacons (12.0 man-hours), application of the primer/base layer (18.5 man-hours), leveling (11.0 man-hours), and final rubbing/texture formation (11.0 man-hours). Therefore, improving efficiency should not be limited to accelerating the application of the decorative layer itself. The principal reserves lie in mechanizing surface preparation, ensuring continuous material supply, mechanizing the application of the base layer, and organizing the workplace using a flow-line sectional method.

Scientific sources indicate that specialized crews, flow-line sectional organization, and the use of high-performance mechanized tools in facade plastering increase productivity and quality. From this perspective, the technological efficiency of decorative finishing works can be represented as $T = f(t, q, n, M, Q)$, where t is the duration of operations, q is material consumption, n is the number of workers, M is the degree of mechanization, and Q represents quality indicators.

CONCLUSION. The methodology of time-and-motion study and operational analysis used for investigating mechanized plastering works can be successfully adapted to decorative finishing works while preserving its essential content. According to the actual calculation in the publicly available technological chart for decorative facade plaster coatings, a labor input of 77.4 man-hours and a work duration of 49.65 hours were recorded per 100 m² of surface. Within the process, application of the base layer, surface preparation, setting out and installation of beacons, leveling, and texture formation have the greatest potential reserves for reducing labor input. Mechanization, flow-line organization of work, and specialized crews make it possible to utilize these reserves, reduce the duration and cost of finishing works, and stabilize coating quality.

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