Reserves and Ways to Reduce Energy Consumption in Monolithic Housing Building in the Construction of the Facility Complex

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Abstract. The main types of energy consumers on the construction site are: construction machines, processes and infrastructure of the construction site. According to research and practical experience, more than 50 varieties of construction machines and mechanisms are used at various stages of construction of the property. Construction machines and mechanisms are integral elements of construction production. For each of them use different types of fuels: liquid fuel, gas, electricity, etc. Also various types of energy processes and maintenance of the construction site. The integral estimation and correct comparison of all energy consumption allows to carry out only their representation in the form of conditional indicators to which all others are given. In comparison with the point construction, the construction of a complex of buildings is characterized by a high integral level of energy consumption. The choice of the method of work production is decisive. This method determines the simultaneous operation of a large number of construction equipment, which leads to a significant increase in energy costs. Analysis of the parameters of organizational and technological models and their corresponding schedules of energy consumption allows you to choose rational organizational and technological solutions for the construction of complex buildings that reduce energy consumption during the construction of buildings.

1. Introduction

Organization of construction production is associated with the development of measures to ensure the construction of facilities and their commissioning in a given time with high quality and optimal financial, labor and material costs. Organizational and technological modeling allows the choice of rational theoretical and practical solutions in the process of construction projects, taking into account various factors, among which one of the essential is energy consumption and, as a consequence, the reduction of energy costs.

To calculate the energy consumption at the construction site, it is necessary to identify and systematize the main types of energy consumers. Detailing the composition of energy consumers at all stages of the construction of separately erected monolithic multi-storey buildings is performed in the previous studies [1-7]. When implementing a complex development project, it is necessary to take into account the methods of work and the order of construction of objects in the complex, which is usually accompanied by the summation of energy capacities.

However, due to the peculiarities of the repair and construction industry, combining the adaptation
of materials and designs of the previous and new generations, as well as combining the types of work that differ in technology and organization, the improvement of manufacturability is associated with the development of new approaches, algorithms, methods, forms and methods that together form technological mechanism.

A characteristic feature of the construction of a complex of objects is the simultaneous use of different types of energy resources. To estimate their total volume, they must be reduced to conventional units. [8-13]

Graphical interpretation of organizational and technological models is a calendar plan, which can be presented in the form of a line chart. The schedule of machines and mechanisms, defined by the schedule, allows you to build a diagram of energy consumption, accompanying mechanized construction processes and work, as well as the intensification of technological processes. Calculation of energy resources required for the operation of the construction site is determined in accordance with the established norms of their consumption.

2. Materials and methods

Construction machines and mechanisms are the most-consumed resources on the construction site. Consumers are represented in table.1.

Table 1. Liquid fuel consumers, electricity consumers, construction site infrastructure.

| Electricity consumer                      | Consumers of liquid fuel                     |
|-----------------------------------------|---------------------------------------------|
| Painting station                        | Tamper                                      |
| Plaster station                         | Bulldozer                                   |
| Heated concrete and the base plate       | Mini-loader                                 |
| Heated utility spaces, and points of protection | Auto concrete pump                           |
| Table for reinforcing                    | Truck mixer                                 |
| Construction hoist                      | Mobile crane                                |
| Vibratory hammer                        | Excavator                                   |
| Heated valves and working areas with heaters | Compressor                               |
| Electric winch                          | Stationary concrete pump                    |
| Welding transformer                     |                                             |
| Electric heating of floors              | Lighting of the premises and the security guards |
| Power tool                              | Lighting exterior flood lights 2 kW (b. 24 hour) |
| Lighting products                       | Emergency lighting                          |
| Thawing of a ground vertical electrode  | Lighting security                           |
| Tower crane                             | Heated utility spaces, and points of protection |

The representative object consisting of 15 residential, monolithic buildings is subject to climatic factors, which can lead to an increase in energy consumption. [14-17]

In the cold climatic period of more than 1000 kW is required for concrete heating, space heating, etc. Consumption of electricity is almost 3 times more than liquid fuels consumption. The data from the table are taken by calculating the number of machines and mechanisms involved in the representative object, taking into account the consumption of each construction mechanism and the duration of construction production.

Interest in improving the sustainability of buildings and reducing their energy consumption is growing all over the world. The observed shift towards sustainable design and operation, as well as cost reduction in solving environmental problems, is relevant in monolithic housing construction in the construction of the facility complex.

The duration of construction is a long time period, including various seasonal conditions and temperature and humidity fluctuations, which, in turn, affect the consumption of energy resources on the construction site. (see Fig.1 and Fig.2.)
Figure 1. Decomposition of mechanized works of fuel and energy resources comparison.

Figure 2. Comparison of the structure of types of consumers of fuel and energy resources at the construction site, depending on different terms of construction.

The reduction of electricity consumption is achieved by changing the start of construction at the design stage (see Fig.3-6).

Figure 3. Chart 01.01.2017-17.10.2017(304 working days).
11 712 944 kW/h.
3. Results and discussion
The object is the representative consists of 15 monolithic houses takes on average 15-16 million kW/h. By changing the start of the construction period consumption kW/h may be reduced to 11 million.

As the main criterion for the successful achievement of this goal, a reduction in the consumption of...
fuel and energy resources by 40%, expressed in specific physical units, or in units of conventional fuel, is accepted. Reduction of energy consumption in the construction industry can be achieved through the implementation of a set of appropriate energy-saving measures: the Combination of energy-corrective measures for all stages of organizational and technological design and construction fully covers the entire investment cycle and can be implemented as a whole and decomposition. In this case, you can choose to evaluate activities for individual types of work, facilities or programs of construction companies and corporations. [18-21]

Methodology of formation of organizational and technological mechanism for the implementation of energy saving measures during the construction of monolithic house building and also includes the methodology of evaluation of reduction of consumption of energy resources in organizational and technological design and during the construction of monolithic housing construction, based on the algorithm of formation and flexible adaptation of the complex energy-saving solutions.

4. Conclusions
Thus, the carried out researches revealed that rational design of monolithic housing construction has reserves of energy saving which can be used at development of the project of production of works in a complex of energy saving actions.

The analysis made it possible to identify the following main reserves in the composition of technological processes and organization of works on the construction site for the development of measures to adjust energy costs on the construction site. These include: mechanized technological processes and work; heat treatment of building structures in the process of construction of the building; organization of work on the construction site (calendar, shift, number of employees); infrastructure of the construction site.

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