Environmental impact consideration in the measures to improve the builders of different specialties working conditions

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Abstract. The paper considers working conditions characterized by the presence of harmful and dangerous factors of the natural and industrial environment, as well as the functional body state of builders performing various jobs. As the subject of scientific research, the levels of harmful and dangerous factors of the labor process in the warm and cold periods of the year and physiological indicators characterizing the dynamics of changes in the functional body state of builders working on open construction sites under the influence of the environment were chosen. The purpose of the research is to develop measures to create safe working conditions, as well as to improve the performance and maintain the health of builders. To achieve this goal, the following tasks were solved: the hygienic features of the working conditions of construction work were determined and the leading natural, industrial, harmful and dangerous production factors were identified; the quantitative and qualitative characteristics of harmful factors and the reasons for their formation were studied; professional characteristics of the work of builders with an assessment of the severity and intensity of the labor process were given; a set of measures aimed at optimizing working conditions and maintaining the health of builders was developed. The paper notes that the whole complex of harmful production factors affects the functional state and performance of builders of various professions. Key words: activities, working conditions, construction professions, unfavorable factors, working environment, physiological indicators, builders health.

1 Introduction

Optimization of working conditions and the working environment creates opportunities for increasing production efficiency, increasing labor productivity and the functional body state of builders, which is the basis for this scientific study [1, 2].

Let us formulate the main provisions on which it is necessary to conduct research.

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1. The working conditions of builders working on open construction sites and indoors can be characterized as unfavorable, since workers are exposed to harmful conditions on construction sites that pose a potential health risk. The working conditions in the main construction specialties are classified as harmful of the 3rd class, 2nd-3rd degree.

2. Determination of the professional characteristics of the work of builders, taking into account the severity and intensity of the labor process, revealed the combined influence of an unfavorable external environment at construction sites, leading to the accumulation of fatigue during the working day, leading to a decrease in the builders working capacity.

3. A set of preventive measures will improve working conditions and prevent the development of production-related and occupational diseases in them.

When studying the scientific literature, it was revealed that a significant number of publications devoted to the characteristics of the working conditions of some groups of construction workers were carried out quite a long time ago (Bluvshtein E.E., 1972; Shibanov N.M., 1967).

Based on the results of the research, preventive measures to optimize working conditions to preserve the health of builders were proposed, and an assessment of the working conditions of builders depending on their professional affiliation and an assessment was given considering the climatic features of the construction areas under consideration was made [3, 4, 5]. The degree of dependence of indicators of the functional state of various systems of the body and the performance of builders on the level of production factors and the nature of labor processes was found [6, 7].

Let’s analyze the relevance of studying the issues of working conditions in the modern construction industry. Technologically, the process consists of the following different stages. The first stage is the "zero cycle", which implies the carrying out of earthworks in order to prepare the construction site, the foundation. The main professional groups in the performance of these works are machine operators, drivers of excavators, bulldozers, and other equipment. The next stage is the construction of the ground part of the building under construction, while the main workers will be tower crane operators and welders. The final stage is various finishing works, including the plumbing installations, laying floors, installing frames, doors, painting, tiling, etc.

Consider the features of occupational health and the organization of the labor process at construction sites in a hot climate. The dependence of the general state of the human body and its vital activity on climatic and meteorological factors was already known in the time of Hippocrates.

According to modern climatology, the word "climate" is understood as a long-term weather regime observed in a given area and determined by a regular sequence of meteorological processes [8, 9].

Builders, more than workers in other specialties, are exposed to meteorological conditions, because construction work is carried out in any weather in open areas.

The features of the physiological reactions of a healthy person in response to the impact of a hot climate were the first stage in the study of climatophysiology. Builders are affected by the whole complex of meteorological factors [10, 11].

Literature data indicate that in the conditions of the hot climate of Central Asia during the daytime, a person experiences a significant tension in thermoregulation. The influence of unfavorable meteorological conditions on the working capacity and labor productivity of builders in open areas in summer in a hot climate was found.

2 Materials and Method

Consider the stages of technological processes during construction work on open construction sites [12, 13].
Construction works are grouped by cycles:

- work of the zero cycle (earthworks, laying the foundation) - excavators, bulldozers, etc.;
- erection of the building frame (laying walls, assembly work) - the main workers are tower crane operators, welders;
- finishing works inside the building (sanitary installations, plastering, painting works).

Let us study the factors of the external natural and industrial environment in the warm and cold periods of the year. Builders, more than workers in other professions, are exposed to meteorological conditions since construction work is carried out in any weather in open areas [14, 15, 16]. For example, in Uzbekistan, from April to September, 60% of the working time of builders, both in the first and second shifts, is spent at temperatures above 30° C, about 1/3 of the working day the air temperature exceeds 35-38° C.

The meteorological conditions under different modes of beginning and ending shifts were characterized as follows: in the morning they were approximately the same and did not go beyond the limits corresponding to thermal comfort [17, 18]. The builders were exposed to the most pronounced effects of high temperature and insolation in the second half of the working day. Under these conditions, builders performed work of a certain intensity [19, 20].

Table 1 shows the maximum and minimum values of the ambient temperature in the summer period of the year in the conditions of Tashkent.

Builders working at temperatures from 0 to 12 degrees Celsius and air speeds of 1-5 m/s, engaged in outdoor work, are subjected to radiation cooling from contact with surrounding surfaces, the temperatures of which are lower than the temperature of the human body (table 2).

Hygienic working conditions for some construction works are shown in table 3, data on the severity and intensity of the labor process of builders when performing various types of work are shown in table 4.

For a comprehensive assessment of the harmful factors levels, it is necessary to study their characteristics separately, taking into account the periods of the year, professional affiliation, i.e. taking into account workplaces and hours of the working day during which the studies were conducted.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Observation hours</th>
<th>6 o'clock</th>
<th>9 o'clock</th>
<th>12 o'clock</th>
<th>16 o'clock</th>
</tr>
</thead>
<tbody>
<tr>
<td>air t (°C) min</td>
<td>+26</td>
<td>+30</td>
<td>+36</td>
<td>+40</td>
<td></td>
</tr>
<tr>
<td>Relative humidity (%) average</td>
<td>50</td>
<td>46</td>
<td>30</td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
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<th>6 o'clock</th>
<th>9 o'clock</th>
<th>12 o'clock</th>
<th>16 o'clock</th>
</tr>
</thead>
<tbody>
<tr>
<td>air t (°C) min</td>
<td>-8</td>
<td>-5</td>
<td>-1</td>
<td>+2</td>
<td></td>
</tr>
<tr>
<td>Relative humidity (%) average</td>
<td>85</td>
<td>80</td>
<td>68</td>
<td>76</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of work</th>
<th>Noise, dB</th>
<th>Dust content, mg/m³</th>
<th>Chemical factor, mg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero cycle</td>
<td>58-105</td>
<td>53</td>
<td>7-35 (CO)</td>
</tr>
<tr>
<td>Erecting a</td>
<td>up to 18-22</td>
<td>7-12 (nitrogen oxides)</td>
<td></td>
</tr>
</tbody>
</table>
Table 4. Severity and intensity of the builders labor process when performing various types of work.

<table>
<thead>
<tr>
<th>Profession</th>
<th>The severity of physical activity</th>
<th>Labor intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rod fixers</td>
<td>III</td>
<td>II</td>
</tr>
<tr>
<td>Tower crane operators</td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>Plasterers, painters</td>
<td>III</td>
<td>II</td>
</tr>
<tr>
<td>Roofers</td>
<td>II</td>
<td>III</td>
</tr>
<tr>
<td>Erectors</td>
<td>II</td>
<td>III</td>
</tr>
<tr>
<td>electric welders</td>
<td>II</td>
<td>III</td>
</tr>
</tbody>
</table>

3 Results

Studies of experimental daily regimes were carried out in 2018-2019 during warm and cold periods of the year. The objects of research were the workers of the building departments "SU-65" and "SU-35" of the Olmazar district with work experience from 10 to 15 years, aged 30-40 years, living in Tashkent. The subject of the study was the working conditions and physiological indicators of the functional body state of the builders. To conduct these studies, the following devices were used: aspirator, meteoscope, gas analyzer "Elen", SVAN-943A.

In the form of diagrams, we present the results of studies of the functional state of the body of builders - the cardiovascular system (CVS) (Fig. 1). On fig. 2 - the results of the examination of the cardiovascular system by arterial pressure (BP).

![Fig. 1](image-url)
The study of the stroke and minute volume of the heart showed that in the dynamics of the work shift there was an equal increase in the SV to 66 ± 1.42 ml and the IOC to 5265.6 ± 101.0 l per minute for both electric welders and tower crane operators.

Particularly noteworthy is the nature and extent of changes in roofers and tower crane operators, whose performance was less favorable than that of electric welders. All this may indicate the depletion of the functional reserves of the CNS of electric welders in comparison with other workers.

Table 5 shows the indicators of the visual-motor reaction of construction workers. The functional state of the motor analyzer is quantitatively characterized by muscle strength. The muscle strength of the right and left hands was studied alternately.

**Table 5.** Indicators of visual-motor reaction in construction workers (M±m), ms.

<table>
<thead>
<tr>
<th>Profession</th>
<th>Warm period</th>
<th>Cold period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before work (I)</td>
<td>Before lunch break (II)</td>
</tr>
<tr>
<td>Electric welders</td>
<td>312.4±1.72</td>
<td>346.2±1.08</td>
</tr>
<tr>
<td>Roofers</td>
<td>270.3±1.43</td>
<td>282.6±1.75</td>
</tr>
<tr>
<td>Tower crane operators</td>
<td>306.5±2.1</td>
<td>369.7±1.52</td>
</tr>
</tbody>
</table>

The results of the research showed that in the dynamics of the working day for the workers whose labor process is associated with static loads, there is a decrease in muscle strength of both the right and left hands (Fig. 3).
In the warm period, these changes were more pronounced than in the cold period of the year. So, in the dynamics of the working day, muscle endurance in all the examined groups decreased on average by 36-37.5% of the background indicators (Fig. 4). Fig. 5 shows a diagram of changes in the auditory-motor reaction of the working builders bodies.

The analysis of the results obtained and the study of the technological process of construction production, the organization of the labor process, the resulting conditions and harmful factors of the working environment showed that among all professions we chose tower crane operators, roofers, assemblers, electric welders, painters, and plasterers.

To determine the dynamics of working capacity of the working main professional groups, hourly timing of the time spent on the implementation of the main production operation was carried out.

The data obtained showed that the greatest changes were found in electric and gas welders and assemblers groups. It was revealed that the complex impact of the factors of the production environment causes a decrease in working capacity by 3 and 6 hours of the working day.

Based on the data obtained, it was concluded that the “standing” working posture of the workers is forced, because the elbow angle, the angle of deviation of the neck and shoulder from the vertical exceed the optimal limit of fluctuations.

**Fig. 3.** Average indicators of builders muscle strength (in kg).

**Fig. 4.** Change in muscle endurance (in seconds).
Discussions

As a set of measures to improve the working conditions of builders of various professions, we propose the following measures.

1. Improve all stages of construction work by improving the layout, equipment used, optimal placement of equipment, mechanization and automation of all work and processes performed.

2. Optimize the microclimate in the working areas, including the arrangement of rest rooms with air conditioners and heaters for the summer or winter work season.

3. In the hot season, it is necessary to start construction work in the earlier morning hours, while the most unfavorable hours of work should be distributed evenly over work shifts.

4. Ensure the availability of drinking water in all areas of construction work in hot weather through the purchase of saturator installations.

5. Provide heating for workplaces maintaining a temperature of 21-25°C during the cold season, including for heating hands and feet at 35-40°C.

6. Provide workers with "hot" meals at lunchtime, as well as provide it ten minutes before work in the cold.

7. To combat air pollution with chemicals and dust in working areas, it is necessary to ensure the sealing of equipment and automation of the technological process, as well as the use of modern devices and equipment for dust cleaning.

8. Protect builders from exposure to noise by providing them with antiphons, ear plugs, and use noise suppression devices when performing certain types of construction work using electrical equipment, when driving piles, etc.

9. Use vibration-damping materials and appropriate personal protective equipment for workers when working with vibrators.

10. Conduct scheduled medical examinations to timely detect occupational diseases and provide timely treatment to reduce the overall incidence of builders.

11. Ensure further improvement of working conditions, considering the emergence of new machinery and equipment for construction work.

Conclusion

Based on the results of the research, the following conclusions can be drawn.

1. The leading harmful production factor in construction work is the unfavorable industrial microclimate, according to which the working conditions of builders are classified as harmful 3rd class 3rd degree. Roofers are exposed to the greatest complex effect of harmful
factors, electric welders are subjected to a somewhat less adverse complex effect of occupational hazards.

2. The hygienic assessment of the working conditions of the main workplaces indicates high levels of noise, dust, and gas contamination of the air in the working area, a forced “standing” working position and physical exertion (grade 3, 2-3 degrees).

3. Evaluation and manifestation of the functional state of the CVS (in the form of an increase in blood pressure, a change in the pulse to a greater extent in roofers and electric welders) revealed a sympathotonic orientation in the regulation of the heart rhythm.

4. Elongation of the latent period of the response to sound and light stimuli by 15-25% was observed among tower crane operators and electric welders.

5. The materials of the conducted studies were the basis for the development of measures necessary for the prevention of production fatigue, increasing the efficiency and maintaining the builders health.

References


