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HYGIENIC FEATURES OF WORKING CONDITIONS IN THE MODERN CONSTRUCTION INDUSTRY

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Abstract
The article analyzes current hygienic aspects of working conditions in the construction industry in the context of technological transformation. The article examines both traditional harmful occupational factors and new risks associated with the introduction of robotics, additive technologies (3D printing of buildings), and digital control. Recommendations are offered for improving occupational disease prevention measures.

Keywords: Occupational hygiene, production risk assessment, construction industry, harmful production factors, preventive measures.

Introduction

The construction industry remains one of the most injury-prone sectors, characterized by a high level of occupational morbidity. Under modern conditions, the construction sector is marked by the widespread adoption of prefabrication (modular construction) and elements of automation. However, despite technological progress, a substantial proportion of work continues to be performed under adverse meteorological conditions and is accompanied by exposure to a complex of harmful factors [1, 2, 10].

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Construction is one of the most important branches of the economy. Despite advances in mechanization, it remains a sector employing a considerable number of workers—often between 9% and 12% of the republic's working-age population. Construction sites involve a wide range of trades, each with its own specific features; at the same time, the vast majority of construction occupations share a number of common characteristics. It should be noted that construction work is no longer seasonal and is carried out year-round. A significant proportion of construction workers are unskilled, while another portion is grouped into occupations requiring skilled labor. In industrially developed countries, construction workers account for 5% to 10% of the total workforce. Worldwide, more than 90% of construction workers are men. In some developing countries, the proportion of women employed in production is higher; however, they are mainly concentrated in occupations that do not require skilled labor [4, 7, 8, 9].

In the republic, the construction of enterprises, buildings, and structures is primarily carried out by contract. The main form of labor cooperation in the construction process is the specialized or integrated brigade, composed of workers from the necessary trades. The steady growth of industrial and civil construction leads to an increase in the number of workers employed in this sector of the national economy.

A modern construction site represents a complex production system involving extensive use of various machines and mechanisms. At present, due to incomplete mechanization and automation and the unfinished modernization of technological processes, manual labor still accounts for a substantial share, resulting in significant physical workloads, uncomfortable microclimatic conditions, high concentrations of dust and various gases, as well as intense noise and vibration. These factors may contribute to the development of diseases of the respiratory system, peripheral nervous system, musculoskeletal system, and cardiovascular system [3, 5, 6].

Specific features of labor in construction production include the combination of closely related occupations due to the performance of various work complexes (2–3 adjacent trades); the absence of permanent workplaces; the need to continuously relocate tools during work, which necessitates addressing issues of optimal movement of workers and construction materials while ensuring safe working conditions; and the involvement, within a single construction project, of workers from multiple construction organizations with differing labor arrangements.

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It has been established that the main hygienic risk factors include dust exposure and chemical hazards, noise and vibration, microclimatic conditions, physical overloads, and ergonomic factors.

Exposure to construction dust (silica, asbestos) and polymer vapors accounts for 17.8% of harmful factors, which is 20% higher than in previous years due to the use of new composite materials. The application of modern composite materials and polymer additives in concrete has expanded the range of chemical substances affecting the respiratory system and skin of workers. Fine particulate matter (including silicon dioxide) remains the primary etiological factor in the development of pneumoconioses and chronic bronchitis. The use of high-powered handheld electric tools and heavy construction machinery generates noise levels exceeding permissible exposure limits by 15–20 dBA. Particular attention is paid to local vibration during operation of innovative concrete compactors. Noise and vibration remain the dominant harmful factors, accounting for up to 47.1% of all adverse exposures in the industry. Work at open construction sites under conditions of climatic instability exposes personnel to the risk of hypothermia or overheating. The introduction of thermoregulating protective clothing partially mitigates this problem but does not eliminate it entirely. Workload severity (manual handling of loads, forced postures) accounts for 20.7% of risks, contributing to the development of musculoskeletal disorders. Heavy physical labor and forced working postures remain leading factors in the development of musculoskeletal diseases.

The mechanisms that have transformed construction into a highly mechanized industrial sector have simultaneously introduced increased noise levels. Typical sources of noise at construction sites include engines of various types (e.g., motor vehicles, air compressors, and cranes), hoisting winches, impact and pneumatic riveting machines, nail guns, paint spray guns, pneumatic hammers, chainsaws, and many others. Intensive noise exposure (up to **50%**) adversely affects workers' central nervous and cardiovascular systems, leading to progressive sensorineural hearing loss and hearing impairment. Vibration is another harmful occupational factor and may be either local or whole-body. Prolonged exposure to local vibration can result in early development of ischemic heart disease, stress-related gastric ulcers, increased risk of myocardial infarction, and ultimately vibration disease. Unfavorable working conditions and the nature of labor cause functional changes

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in workers' bodies, primarily manifested as strain on thermoregulatory processes, the central nervous and cardiovascular systems, and the neuromuscular apparatus, indicating the predominant influence of physical and neuropsychological loads in combination with other harmful occupational factors. A number of authors have also established that dust at construction sites is not only the most prevalent adverse factor but that its levels significantly exceed permissible concentrations.

Under modern conditions, the hygienic situation in the construction industry is characterized by the persistence of high exposure to physical factors alongside the gradual introduction of digital health monitoring. At present, the structure of occupational pathology among construction workers is as follows: diseases of the musculoskeletal system account for 53% of all registered work-related cases. Sensorineural hearing loss and vibration disease (up to 38.5% in certain sub-sectors) remain the leading conditions associated with physical factors. Among respiratory diseases, new cases of lung pathology caused by inhalation of construction dust and chemical agents are recorded annually.

To minimize risks in the modern construction industry, technological advancement is required, namely a transition from "wet" processes to the assembly of prefabricated factory-made modules. Particular emphasis is placed on the use of respiratory protective equipment with forced supply of purified air when working with polymer compounds. In medical surveillance, the implementation of regular medical examinations and automated pre-shift health monitoring systems plays a key role in prevention. For organizing a rational work–rest regime, optimization of regulated breaks during work under extreme temperature conditions is considered, taking into account data from personal biodetection devices.

In addition, considering the above, the features of modern prevention include the ergonomic principles of the labor process, aimed at reducing compressive loads on the spine, which potentially lowers the risk of radiculopathy—diagnosed on average in every fourth construction worker with more than 10 years of service. The use of modern wearable biodetectors enables the preventive identification of premorbid conditions (overheating, critical fatigue) among construction workers before they seek medical care. Digital monitoring is also being implemented through wearable devices, allowing real-time tracking of heart rate, respiratory rate, and body temperature, thereby preventing critical overloads.

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Conclusion

An analysis of the literature indicates that the specific characteristics of construction workers' labor conditions remain insufficiently studied, necessitating further research into the formation of harmful occupational environmental factors, their impact on various functional systems of the body, and the health status of construction workers operating under the climatic and geographical conditions of Uzbekistan.

Occupational hygiene in the construction industry in 2025 requires an integrated approach that combines classical protective methods with digital risk management technologies. A reduction in occupational morbidity is possible only through the synergy of engineering solutions (robotization) and stringent sanitary and epidemiological control over new technological processes.

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