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ON CONSTRUCTION EFFICIENCY INCREASE IN MOUNTAINOUS CONDITIONS

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In the present paper we have systematized and revealed regularities of climatic factors dynamic change in mountainous conditions. Multifactor mathematical models were developed designed to assess deviations of construction parameters in such conditions where the main parameters are duration of labor and technical resources use, vehicle transportation, storage of production reserves, construction time.
Recommendations have been submitted for practical application of multifactor mathematical models in organizational, technological and engineering solutions leading to construction efficiency increase.

Key words: *climatic factors, influence, construction process, deviation, cost price, efficiency.*

Analyzing operational experience of building organizations of Armenia and Nagorno Karabagh, we have solved problems of systematization and revelation regularities of climatic factors dynamic change depending on altitude above sea level (h), modeling of construction parameters deviations, optimization of organizational management and etc. [1,3].

Factors of mountainous conditions are subdivided into the following groups.

1. Geomorphologic factors
1.1 Tortuosity of roads and ruggedness of relief – factor $X_{1.1}$. Criterion for estimation of this factor is a coefficient determined by ratio of actual length of a road between two points to its shortest length on the plan of locality.

This factor is determined by the following expression

$$X_{1.1}=0,4604+1,411 \times 10^{-3}h$$

1.2 Seismicity – factor $X_{1.2}$. With altitude rise a tendency to increase horizontal acceleration of soils is observed. However, there is no strongly pronounced character of their development along the vertical, since this index mainly depends on geological conditions of construction site. These conditions are markedly distinguished by heterogeneity.

1.3 Hardness and stoniness of soils, relief complexity – factors $X_{1.3}$ and $X_{1.4}$. At the cost of these factors construction duration increases on the average 1.08 times regardless of the relief altitude above sea level.

1.4 Soils' frost zone – factor $X_{1.5}$. Taking into consideration the difference of soils properties conditioned some frost zone spread in values and is on the average 60 to 70 cm in height of mountainous relief.

1.5 Falling - landslide processes – factor $X_{1.6}$. Maximum development of these processes occur at altitudes 800 to 1000m above sea level and 34 percent. No regular development the above processes is observed.

2. Climatic and geological factors
2.1 Atmospheric precipitations – factor $X_{2.1}$. The rainfall amount for April to June period exceeds over twofold average monthly figures as compared with the rest of months of the year. Average annual rainfall amount depending on altitude above sea level is determined by the following formula

$$X_{2.1}=33.56+472.56 \times 10^{-3}h - 80 \times 10^{-6}h^2, mm.$$

2.2 Air temperature – factor $X_{2.2}$. Average annual air temperature below 800m of altitude above sea level and has positive value. Within the altitudes from 800m to 2000m duration the weather with temperature below zero is 3-4 months, and over 2000m above sea level is 5 to 8 months.

$$X_{2.2}=18.557-7.091 \times 10^{-3}h, C$$

2.3 Wind speed – factor $X_{2.3}$. Taking into consideration directivity of mountain and valley winds was established dependence of change along the vertical of average annual wind speed:

$$X_{2.3}=0.8236 + 0.836 \times 10^{-3}h, m/s$$

2.4 Barometric pressure – factor $X_{2.4}$. Barometric factor decrease along verticals is reflected on adaptation (readaptaion) regimes of employees, productivity of labor, vehicle movement duration, etc.

$$X_{2.4}=1000 – 0.11h+0.41 \times 10^{-3}h^2, GPa$$

2.5 Number of days with snow blanket – factor$X_{2.5}$. Snow blanket time in mountainous regions depends on elevation, relief. form and exposition of slopes and is of form

$$X_{2.5}= 81.689 – 118.631 \times 10^{-3}h +75.128 \times 10^{-6}, days.$$

2.6 Air moisture – factor $X_{2.6}$. Depending on the season the relative moisture of air in mountainous regions differs both in value and character of distribution. In summertime the air relative moisture amounts to maximum values at 2000m above sea level. In winter relative moisture distribution pattern has almost opposite to the picture as compared with summer months pattern.

$$X_{2.6}=60.68 + 4.45 \times 10^{-3}h, \%$$

3. Organizational, technical, technological and social factors

This group of factors involves: infringement of material and technical resources delivery timelines, low level of methods of labor and production, building and assembly jobs organization, changes of work organization technology, social and life conditions, etc.

Due to influence of these factors construction time increases in 1.16 times and has a constant character along the vertical.

On the basis of revealed regularities and dynamics of climatic factors increase multifactor mathematical models have been developed reflecting change of construction parameters in mountainous conditions [4,5].

1. Time of labor resources use (K^h_{mp}). This parameter is formed under influence of a wide range of climatic, organizational, technological, technical, social and other factors

$$K^h_{mp}= 216-14Z_{21}-2Z_{2.2}-2Z_{2.3}-Z_{2.4}-7Z_{2.5}-15Z_{2.3}$$

2. Technical-organizational reliability of usage of technical resources ($K_{omн}$). This reliability is evaluated as a ration of actual time of use of technical resources to normative one

$$K^h_{omн.} = 0.272+0.053 Z_{2.1}+0.120Z_{2.2}+0.157Z_{2.3}+0.123Z_{2.5}+0.044Z_{2.6}+0.222K^h_{mp}$$

3. Time of vehicle movement (K^h_{mp}). This parameter is formed by conditions of impassibility of roads, state of roads, dispersion of facilities under construction, climatic factors and etc.

$$K^h_{mp.} = 0.190+0.469\ Z_{1.1}+0.134Z_{2.1}+0.106Z_{2.4}+0.099Z_{2.1.}\ Z_{2.6}$$

4. Storage time of production reserves (K^h_{xp}). Most typical factors having an influence on K^h_{xp} are resource transportation conditions, seasonal nature of work, downtime caused by weather conditions and etc.

$$K^h_{xp}= 1.964+0.238\ K^h_{mp}+0{,}127Z_{1.1}+0.204Z_{2.1}$$

In the above mentioned formulae coefficients of climatic factors' development dynamics along the vertical.

5. Construction time (K^h_{np}) is determined subject to coefficients of each factor weight using the "Delfi" method [5]

$$K^h_{np}=1.45+0.250\ \delta_{1.1}+0.222\delta_{2.1}+0.186\delta_{2.2}+0.113\ \delta_{2.3}+0.133\ \delta_{2.4}+0.059\delta_{2.5}+0.037\delta_{2.6},$$

where $\delta_{1.1}$, $\delta_{2.1}$, $\delta_{2.2}$, $\delta_{2.3}$, $\delta_{2.4}$, $\delta_{2.5}\ \delta_{2.6}$ are coefficients of weight influence of $X_{1.1}$, $X_{2.1}$, $X_{2.2}$, $X_{2.3}$ $X_{2.4}$, $X_{2.5}$, $X_{2.6}$ factors.

The presented multifactor models of construction parameters change is recommended for use in organizational, technological and engineering solutions of construction efficiency increase in mountainous conditions. Examples of solution of similar problems can be found in the works [2,6].

Conclusions
1. Regularities of climatic factors development in mountainous conditions along the vertical have been systematized and revealed.
2. Multifactor mathematical models have been developed designed for determining deviation of construction parameters depending on height of facilities under construction above sea level .
3. Recommendations were made of the use in organizational, technological and engineering solutions for providing increase in construction efficiency in mountainous conditions.

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ԼԵՌՆԱՅԻՆ ՊԱՅՄԱՆՆԵՐՈՒՄ ՇԻՆԱՐԱՐՈՒԹՅԱՆ ԱՐԴՅՈՒՆԱՎԵՏՈՒԹՅԱՆ ԲԱՐՁՐԱՑՄԱՆ ՀԱՐՑԻ ՎԵՐԱԲԵՐՅԱԼ

Ռ.Գ. Իսրայելյան, Ա.Ա. Պողոսյան

Շուշիի տեխնոլոգիական համալսարան

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Համակարգված և հայտնաբերված են լեռնային բնակլիմայական պայմանների գործոնների զարգացման օրինաչափությունները: Մշակված են բազմաֆակտորային մաթեմատիկական մոդելներ, նշված պայմաններում աշխատանքային, տեխնիկական ռեսուրսների և ավտոտրանսպորտային միջոցների օգտագործման, արտադրության պաշարների պահեստավորման, շինարարության երկարատևության պարամետրերի փոփոխման գնահատման նպատակով:

Բերվում է առաջարկություններ շինարարության արդյունավետության բարձրացման համար` բազմաֆակտորային մաթեմատիկական մոդելների պրակտիկ օգտագործման կազմակերպչական, տեխնոլոգիական և տեխնիկական լուծումներում:

Բանալի բառեր. կլիմայական գործոններ, ազդեցություն, շինարարական պրոցեսներ, շեղումներ, ինքնարժեք, արդյունավետություն:

К ВОПРОСУ О ПОВЫШЕНИИ ЭФФЕКТИВНОСТИ СТРОИТЕЛЬСТВА В ГОРНЫХ УСЛОВИЯХ

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Систематизированы и выявлены закономерности развития природно-климатических факторов горных условий. Разработаны многофакторные математические модели по оценке

46

отклонений этих условиях параметров использования трудовых и технических ресурсов, автотранспортных средств, хранения производственных запасов и продолжительности строительства.

Даны рекомендации по повышению эффективности строительства, с практическим применением математических моделей в организационно - технологических и технических решениях.

Ключевые слова: природно-климатические факторы, воздействия, строительные процессы, отклонения, математические модели, оптимизация, параметры, себестоимость, эффективность.