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CALCULATING THE WEAR INDICATORS OF MOUNTAIN ROADS' STRUCTURES AND THEIR EFFECTS ON THE ENVIRONMENT'S VULNERABILITY

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Abstract

The lack of clear boundaries of the vertical climatic zonality of mountainous countries in the norms for building climatology leads to errors in the timing of the interrepair work of highways. Given in GOSTs and other regulatory documents, these terms are of an average nature. For this reason, pavement structures and vehicles (road transport system) are subjected to premature wear and tear, and harmful emissions into the environment of mountainous areas increase.

In order to increase the durability of pavement structures of mountain roads and reduce harmful emissions into the environment, a method is proposed for determining the optimal time between repairs of mountain roads, taking into account the integrated indicators of their wear, under the influence of natural and climatic factors of mountain conditions.

It has been determined how these elements affect how ecologically vulnerable mountainous places are, and the ideal time frame for lowering the need for mountain road maintenance has been provided.

The effectiveness of mathematical models and the reliability of the working hypothesis on the proportionality of the optimal periods for reducing overhaul life and the environmental vulnerability of mountainous areas have been proved.

Keywords: mountain roads, natural and climatic factors, harmful emissions, environmental vulnerability.

Introduction

The road transportation system experiences significant wear due to the influence of vertical climate elements that are dynamically growing in mountain environments. Due to these factors, the environment is becoming more polluted, including soil, air, and water bodies, as well as from road vibrations and noise, which causes environmental deterioration in hilly places.

The period between repairs of mountain roads along the vertical zonality of mountain regions, which is now poorly understood, can be reduced, according to an examination of the current regulatory documents and studies on the issue [1-11].

When calculating the reduction of the turnaround time, averaged indicators are used for the altitude ranges of 1000-1500 and 1500-2000 meters above sea level, where the reduction in these periods is 7% and 10%, respectively. In case of loss of stability of the subgrade, their reduction to 30% is allowed [12]. To determine the optimal time between repairs of roads, a mathematical model is proposed that reflects the environmental vulnerability of mountainous areas from the operation of the road transport system along vertical zonality.

Conflict Setting

1. In the creation of mathematical models that depict the dynamics of vertical changes in mountain environments caused by natural and climatic variables. For the altitude ranges of 800-2000 meters above sea level, the models are created with a height gradation of 200 meters, encompassing the regions with the highest population in mountainous nations.
2. In the creation of a mathematical model that depicts the environmental vulnerability of mountainous regions due to the operation of the road transportation system, under the effect of natural and climatic variables, as well as cars (external factors).
3. In accordance with vertical zoning, choose the best time to start inter-repair work on roadways.

Research methodology:

1. Statistical experiments and modeling of changes in natural and climatic factors of mountain conditions by vertical zonality.
2. Development of a mathematical model of the environmental vulnerability of mountainous areas from the operation of the road transport system.

3. Determination of the optimal time between repairs of mountain roads according to vertical zonality.
4. Verification of the reliability of the obtained factors.

Research Results

It has been established that the main volumes of construction and operation of automobile works in mountainous areas are carried out at altitudes of 800-2000 meters above sea level. For these conditions, mathematical models of vertical changes in natural and climatic factors have been developed. Tab. 1, [13-15].

Table 1

Mathematical models of the development of natural and climatic factors in mountainous areas within the heights of 800-2000 meters above sea level

Indicators	Height above sea level *h, m*						
	800	1000	1200	1400	1600	1800	2000
Relief complexity	$X_{1.1} = 04.604 + 1.411 \times 10^{-3}h$						
Value X1.1	1.60	1.90	2.20	2.40	2.70	3.00	3.28
Dynamics at altitude 800 m, Z1.1	1	1.18	1.36	1.53	1.73	1.89	2.05
Precipitation	$X_{2.1} = 33.56 + 472.56 \times 10^{-3}h - 80\times10^{-6}h^2$, *мм*						
Value X2.1	360.3	425.9	485.1	537.2	584.3	624.7	657.3
Dynamics at altitude 800 m, Z2.1	1	1.18	1.35	1.49	1.62	1.73	1.82
Air temperature	$X_{2.2}= 18.557-7.091 \times 10^{-3}h$, Cº						
Value X2.2	12.9	11.5	10.1	8.6	7.2	5.8	4.4
Dynamics at altitude 800 m, Z2.2	1	0.89	0.78	0.67	0.56	0.45	0.34
Winds	$X_{2.3} = 0.8236 +0.836\times10^{-3}h$, *m/s*						
Value X2.3	1.49	1.66	1.82	1.99	2.16	2.38	2.5
Dynamics at altitude 800 m, Z2.3	1	1.11	1.22	1.34	1.45	1.6	1.67
Barometric pressure	$X_{2.4} = 1000-0.11h+0.41\times10^{-5}h^2$, *Гпа*						
Value X2.4	929	909	889	869	849	83	2811
Dynamics at altitude800 m, Z2.4	1	0.98	0.96	0.94	0.91	0.89	0.87
Number of days with snow cover	$X_{2.5} = 81.689-118.631\times10^{-3}h+75.128\times10^{-6}h^2$, *days*						
Value X2.5	34.9	38.2	47.6	62.9	84.2	11.6	144.9
Dynamics at altitude800 m, Z2.5	1	1.09	1.36	1.8	2.41	3.19	4.15
Air humidity	$X_{2.6} =60.68+4.45\times10^{-3}h$, *%*						
Value X2.6	64	65	66	67	68	68	70
Dynamics at altitude 800 m, Z2.6	1	1.02	1.03	1.05	1.06	1.06	1.09

It should be noted that during the study, less significant factors were excluded, which include:
1. **Squally winds.** According to reference data and the results of our research, the wind speed at an altitude of 2000 meters above sea level is only 2.5 m/s. (which is not comparable with the speed of 8-11 m/s) for squally winds;
2. **Snow avalanches**. Forecasting the development of these processes is carried out on the basis of engineering and geological surveys. Within the altitudes of 2000-2500 meters there are forests that prevent avalanches from descending to lower altitudes;
3. **Landslide processes**. Forecasting the development of these processes is carried out on the basis of engineering and geological surveys. The highest frequency of these processes for the conditions of Nagorno-Karabakh is observed at altitudes of 800-1000 meters above sea level (34%). This figure at altitudes of 1000-1600 meters is, respectively, 9% -13%. The

development of landslide processes is of a discrete nature and is specified for each case when allocating sites for construction;
4. **Mudflows.** Forecasting the development of mudflows in mountainous areas is carried out by means of maps of mudflow-bearing regions, which are taken into account when allocating land for construction;
5. **Collapses and screes.** The area of the greatest distribution of these processes covers absolute heights from 1000 to 3000 meters. Mountainous areas, as a rule, have permanent centers of occurrence and possible directions of movement, which are also taken into account when allocating land for construction;
6. **Seismicity**. With an increase in altitude above sea level, there is a certain trend towards an increase in horizontal ground accelerations. However, there is no pronounced character of their development along the vertical; this indicator depends on the geological conditions of construction, which in mountainous conditions are not very diverse;
7. **Depth of soil freezing**. Within the limits of heights from 800 to 2000 meters, the depth of soil freezing is 60-70 cm;
8. **Number of days with fog.** The formation of fog in mountainous areas depends on the season, height above sea level, atmospheric circulation, physical and geographical conditions, etc. Under these conditions, the formation of fogs is of a complex nature without their regular development. In some cases, in high mountain areas, the number of days with fog can be 35% per year or more. This is facilitated by a decrease in altitude of barometric pressure and air temperature, as well as an increase in wind speed and relative humidity.

To predict the influence of external factors on the state of mountain roads, methods of mathematical forecasting (the “Delphi” method) and process control modeling [16-18] are adopted.

Table 2

Weight coefficients of the impact of external factors on the wear and tear of the road transport system in mountainous areas

Factors	A	B	C	D
Relief complexity	54	6	36	0.1607
Precipitation	60	12	144	0.1786
Air temperature	58	10	100	0.1726
Wind speed	21	27	729	0.0625
barometric pressure	52	4	16	0.1548
Number of days with snow cover	71	23	529	0.2113
Relative humidity	20	28	784	0.0595
Total	336	-	3496	1.00
Convergence calculation $W = \frac{12 \times 3496}{12^2(7^3-7)} = 0.87$				
Note: A is the sum of ranks; B - deviation from the arithmetic mean; C - square deviation; D - weight coefficients of factors.				

Calculations according to the Delphi method were carried out using a computer program developed by us, in which the degree of reliability of forecasts was determined by the convergence of the results obtained by the formula:

$W = \frac{12S}{m^2(n^3-n)}$, where m is the number of experts; n is the number of factors; S is the sum of the squared deviations of the estimates of the ranks of each factor. In this case, the convergence values of the results should be within $0.5 \leq W \leq 1$.

In Tab. 2 gives an example of determining the weight coefficients of the impact of external factors on the wear and tear of the mountain road transport system in mountainous areas.

The generalization of the forecasting results was carried out in several stages, until the coefficient of convergence of the results of values from 0.5 to 1.0 was reached. In our case, W=0.87, which confirms the high degree of reliability of the forecasts. Integrated indicators of the impact of external factors on the vulnerability of road areas from the operation of the road transport system are given in Tab. 3.

Table 3

Coefficients characterizing the ecological vulnerability of mountain districts from the operation of the road transport system

Factors	Height above sea level *h*, m						
	800	1000	1200	1400	1600	1800	2000
Relief complexity	0.161	0.192	0.221	0.242	0.272	0.301	0.332
Precipitation	0.179	0.211	0.242	0.267	0.267	0.310	0.328
Air temperature	0.173	0.194	0.222	0.258	0.258	0.384	0.509
Wind speed	0.063	0.071	0.076	0.084	0.084	0.096	0.105
barometric pressure	0.155	0.160	0.163	0.167	0.167	0.176	0.182
Days with snow	0.211	0.232	0.287	0.380	0.380	0.656	0.878
Air humidity	0.060	0.061	0.061	0.062	0.062	0.064	0.065
Total	1.000	1.121	1.263	1.987	1.398	1.987	2.399

The mathematical model of changes in the environmental vulnerability of mountainous areas from the operation of road transport has the form:

$$P_1 = 0.161Z_{1.1} + 0.179Z_{2.1} + 0.173Z_{2.2} + 0.063Z_{2.3} + 0.155Z_{2.4} + 0.211Z_{2.5} + 0.060Z_{2.6} \quad (1)$$

where $Z_{1.1}$, $Z_{2.1}$, $Z_{2.3}$, $Z_{2.4}$, $Z_{2.5}$, $Z_{2.6}$ – dynamics of changes in natural and climatic factors of mountain conditions by vertical zonality (Tab. 1).

Table 4

Analysis of the convergence of calculations based on a mathematical model with current building codes

Indicators	800	1000	1200	1400	1500	1600	1800	2000
Model calculation results	1.0	1.210	1.263	1.398	1.554	1.711	1.987	2.399
Average value for heights 1000-1500 m	(1.210+1.263+1.398+1.554):4 =1.356					-		
Also, for altitudes of 1500-2000 m	-				(1.554+1.711+1.987+2.399):4=1.913			
Decrease - according to VSN 41-88, for heights of 1000-1500 m, %	7					-		
Also, for heights of 1500-2000 m, %	-				10			
Proportionality according to the model	1.913:1.356=1.411							
The same, according to VSN - 41-88	10:7=1.429							
Deviation, %	1.26							

On the basis of the mathematical model, the optimal terms for performing the overhaul works of mountain roads are calculated. A working hypothesis is proposed that the coefficients for reducing the terms of these works should be commensurate (inversely proportional) to the coefficients of changes in the environmental vulnerability of mountainous areas by vertical zonality

The reliability of the hypothesis is confirmed by the convergence of calculations according to the model with the current building codes, Tab. 4.

Based on the calculations (Table 4), the coefficients for reducing the time between repairs of mountain roads by vertical zonality were determined - P_2 (Tab. 5). The results obtained confirmed the validity of our hypothesis.

Table 5

Coefficients for reducing the time between repairs of mountain roads

Indicators	Height above sea level *h*, m							
	800	1000	1200	1400	1500	1600	1800	2000
Calculation results for the -P1 model	1.00	1.210	1.263	1.398	1.554	1.711	1 987	2.399
Coefficients reducing the time between overhauls	1.00	0.826	0.792	0.715	0.643	0.584	0.503	0.417
Medium to 1000-1500 m altitude	(0.826+0.792+0.715+0.643):4=0.744					-		
The average value of the coefficient. to an altitude of 1500-2000 m	-				(0.643+0.0584+0.503+0.417):4=0,537			
Proportionality according to the model	$(0.537:0.744)^{-1}$ = 1.385							
The same, according to VSN - 41-88	10:7=1.429							
Deviation, %	3.1							

The results of the study were introduced into the curriculum in universities, according to the textbooks recommended by the RA Ministry of Education and Science for universities [19].

The basis of the position of the work was reported and published in the materials of international scientific conferences [20-21].

Conclusion

1. The systematization of natural and climatic factors in mountain conditions has been carried out and a quantitative assessment of their development by vertical zonality in the altitude ranges of 800-2000 meters above sea level has been given.
2. A mathematical model has been developed for changing the environmental vulnerability of mountainous areas from the operation of road transport systems, taking into account their vertical zonality.
3. The effectiveness of the mathematical model and the reliability of the working hypothesis about the proportionality of the timing of the completion of overhaul works and the vulnerability of the environmental ecology of mountainous areas have been proven.
4. The reliability of the results of mathematical modeling and the timing of the reduction in the overhaul of highways according to the vertical zonality of mountainous areas has been proved.

References

1. Lukashevich O.D., Lukashevich V.I. (2020) Increase of ecological security of engineering and exploitation of roads //Bulletin of Tomsk University of Engineering and Construction, vol. 5.- pp. 200-210.

2. Lukashin V.N., Trofimenko Yu.V. (2001) Industrial and road ecology //M: High school, 2001.- 273 p.
3. Khotenko O.A. (2018) Legacy of ecological safety of road activity //Ecological law, M., N1.- 174-182p.
4. Alekseev S.V., Somonov D.A., Kotikova A.S. (2022) The impact of natural factors on the condition of roads in various regions of Russia, Saint Petersburg Polytechnic University, Magazine of Innovative transport systems and technologies, vol. 8, N4, 2022.- pp. 14-30.
5. GHN 218.046-2001, Design of soft road uniforms, M: 2001.
6. Olisaeva L.G., Kaloev T.A. Highways as source of environmental pollution in mountainous areas, Bulletin of MASES, vol.9, 2004.- p. 101-105
7. GHN 218.016-2002, Concepts and norms of roads, M: 2003.
8. GHN 2183.4.031-2013, Methodological instructions of environmental security during construction, reconstruction and content of roads
9. GOSTR 58861-2020, Roads of public use, Capital reconstruction and projecting of inter -reconstruction terms
10. Shuvalov A.N., Panova M.V. (2003) Reliability and long lasting of roads in mountainous areas //Proceedings of CJSC Giprodormash, 2013, N4.- p.14-19
11. CNR 23-01-99, "Engineering climate", M: 2003.- 308 p.
12. HCN N 41-88, Regional industrial norms of inter-reconstruction terms of road uniform and coverage services, M: 1999.
13. Israyelyan R.G. (2015) Modeling of denying of duration of construction in mountainous areas //Audit and financial analyses, N19.- pp. 120-123.
14. Oleinik P.P., Israyelyan R.G., Israyelyan M.A. (2021) Peculiarities of engineering-ecological solutions of increasing the efficiency of construction in mountainous areas //Civil and industrial engineering, M: 12/2021.- p. 47-54, DOI: 10.33622/0869-7019.2021.12.47-54
15. Oleinik P.P., Israyelyan R.G., Israyelyan M.A. Modeling of industrial force of constructions in mountainous areas //M: Industrial engineering (IE).- p. 9-13, DOI:10.54950/26585340_2022_4_9
16. Shikin E.V., Chkhartishvili A.G. (2002) Mathematical models in management //2nd edition, M: publishing house "Delo", 2002.- 440 p.
17. Kulbanov M.S. (2015) Testing of appropriateness of mathematical models //Scientific bulletin MSTU IA, N211.- pp. 29-36.
18. Mikhaylova P.M., Kuznetsova O.A., Petrov A.V. (2019) Application of the method "Delfy" as an instrument of forecasting the market //International scientific -research magazine, N3(81).- pp. 106-110.
19. Israyelyan R.G. (2015) Basics of construction structures in mountainous conditions //NUAISA, Yerevan.-135 p.
20. Israyelyan R.G., Hayrapetyan V.G., Zakharyan G.E. (2017) The estimation of ecological risks of dam hydroelectric power stations in natural climatic conditions of mountainous areas //Proceedings of international conference of "Ecologically safe technologies of natural construction and water utilization, theory and practice", to the

25th anniversary of the program UNITVIN of chair UNESCO, Novosibirsk, 19-20 June.- pp. 189-193.

21. Israyelyan R.G., Oleinik P.P, Barseghyan A.A. (2014) Modeling of construction organizations mobility in the mountainous conditions //International conference of European science and Technology, Munich, Germany.- pp. 87-89.

References

1. Лукашевич О.Д., Лукашевич В.И. (2020) Повышение экологической безопасности строительства и эксплуатации автомобильных дорог //Вестник Томского архитектурно-строительного университета, Т. N5.- с. 200-210.
2. Лукашин В.Н., Трофименко Ю.В. (2001) Промышленно-транспортная экология //М: Высшая школа.- 273 с.
3. Хотенко О.А. (2018) Юридическая природа экологической безопасность транспортной деятельности //Экологическое право, М: N1 2018.- 174-182 с.
4. Алексеев С.В., Симонов Д.А., Котикова А.С. (2022) Воздействие природных факторов на состояние дорог в различных регионах России //Санкт-Петербургский Политехнический университет, журнал Инновационные транспортные системы и технологии том 8, N4.- с. 14-30.
5. ОДН 218.046-2001 Проектирование нежестких дорожных одежд. М: 2001.
6. Олисаева Л.Г., Калоев Т.А. (2004) Автомобильные дороги, как источники загрязнения окружающей среды в горных районах //Вестник МАНЭБ, Т.9.- с. 101-105.
7. ОДН 218.5.016-2002. Понятия и нормы безопасности автомобильных дорог. М: 2003.
8. ОДН 2183.3.031-2013. Методические рекомендации по охране окружающей среды при строительстве, ремонте и содержании автодорог.
9. ГОСТ Р 58861-2020. Дороги автомобильные общего пользования. Капитальный ремонт и планирование межремонтных сроков.
10. Шувалов А.Н., Панова М.В. Надежность и долговечность автомобильных дорог в горных условиях (2013) //Сборник научных трудов ОАО Гипродормаш, N4.- с. 14-19.
11. СНиП 23-01-99* “Строительная климатология”. М: 2003.- 308 с.
12. ВСН 41-88 Региональные отраслевые нормы межремонтных сроков службы дорожных одежд и покрытий, М: 1999.
13. Исраелян Р.Г. (2015) Моделирование отклонений продолжительности строительства в горных условиях //Аудит и финансовый анализ, N9.- с. 120-123.
14. Олейник П.П., Исраелян Р.Г., Исраелян М.А. (2021) Особенности эколого-инженерных решений повышения эффективности строительства в горных районах //Промышленное и гражданское строительство (ПГС). М: 12/2021.- с.47-54. DOI:10.33622/0869-7019.2021.12.47-54
15. Олейник П.П., Исраелян Р.Г., Исраелян М.А. (2022) Моделирование производственной мощности строительной организации в природно-климатических условияh горных районов //М: Строительное Производство (СП).- с. 9-13. DOI:10.54950/26585340_2022_4_9

16. Шикин Е.В., Чхартишвили А.Г. (2002) Математические методы модели в управлении //2-е издание. М., Издательство <<Дело>>.- 440с.
17. Кулбанов М.С. (2015) Проверка адекватностей математических моделей //Научный вестник МГТУ ГА, N211.- с. 29-36.
18. Михайлова П.М., Кузнецова О.А., Петров А.В. (2019) Применение метода <<Дельфи>> как инструмента прогнозирования рынка //Международный научно-исследовательский журнал. 2019, N3 (81).- с. 106-110.
19. Исраелян Р.Г. (2015) Основы организации строительства в горных условиях //NUAISA, Ереван.- 135 с.
20. Исраелян Р.Г., Айрапетян В.Г., Захарян Г.Э. (2017) Оценка экологических рисков приплотинных гидроэлектростанций в природно-климатических условиях горных районов //Материалы международной конференции «Экологические безопасные технологии природообустройства и водопользования: теория и практика», посвященной 25-летию программы УНИТВИН кафедры ЮНЕСКО, Новосибирск, 19–20 июня 2017 г. Партнеры Сибири.- с. 189-193.
21. Israelyan R.G., Oleinik P.P., Barsegyan A.A. (2014) Modeling of construction organizations' mobility in the mountainous conditions //International Conference on European Science and Technology. Munich, Germany 2014.- p. 87-89.

ԼԵՌՆԱՅԻՆ ԱՎՏՈՄՈԲԻԼԱՅԻՆ ՃԱՆԱՊԱՐՀՆԵՐԻ ԿՈՆՍՏՐՈՒԿՑԻԱՆԵՐԻ ՄԱՇՎԱԾՔԻ ՑՈՒՑԱՆԻՇՆԵՐԻ ՀԱՇՎԱՐԿԸ ԵՎ ՆՐԱՆՑ ԱԶԴԵՑՈՒԹՅՈՒՆԸ ԱՐՏԱՔԻՆ ՄԻՋԱՎԱՅՐԻ ԽԱՓԱՆՄԱՆԸ

Ռ.Գ. Իսրայելյան, **Ն.Ա. Միքայելյան**, **Մ.Ա. Իսրայելյան**, **Ա.Ա. Ասլանյան**
Շուշիի տեխնոլոգիական համալսարան

Շինարարական կլիմատոլոգիայի նորմաներում բացակայում են լեռնային շրջանների ուղղաձիգ գոտիավորման հստակ սահմանները, որոնք բերում են ավտոմոբիլային ճանապարհների, վերանորոգման աշխատանքների կատարման ժամկետների խափանմանը:

Նորմատիվային փաստաթղթերում նշված կատարման ժամկետներն ունեն միջինացված բնույթ: Այդ առումով ավտոճանապարհները և ավտոտրանսպորտային միջոցները (ճանապարհա-տրանսպորտային համակարգ) ենթարկվում են ինտենսիվ մաշվածքի՝ ավելանում է վնասատու արտանետումը լեռնային գոտիների շրջակա միջավայր:

Ավտոճանապարհների կոնստրուկցիաների երկարակեցության բարձրացման նպատակով և վնասատու արտանետումը արտաքին միջավայրում նվազեցնելու համար առաջարկվում է ավտոմոբիլային ճանապարհների վերանորոգման օպտիմալ ժամկետների որոշման մեթոդը, հաշվի առնելով նրանց մաշվածքը լեռնային բնակլիմայական գործոնների ազդեցության տակ:

Ապացուցված են մաթեմատիկական մոդելների էֆեկտիվությունը, աշխատանքային հիպոթեզի հավաստիությունը և համաչափությունը, որոշված ավտոճանապարհների վերանորոգման օպտիմալ ժամկետների, նաև՝ լեռնային շրջանների էկոլոգիական խոցելիությունը:

Բանալի բառեր. լեռնային ավտոմոբիլային ճանապարհներ, բնակլիմայական գործոններ, վնասատու արտանետումներ, էկոլոգիական խոցելիություն:

РАСЧЁТ ПОКАЗАТЕЛЕЙ ИЗНОСА КОНСТРУКЦИЙ ГОРНЫХ АВТОМОБИЛЬНЫХ ДОРОГ И ИХ ВЛИЯНИЕ НА ЭКОЛОГИЧЕСКУЮ УЯЗВИМОСТЬ ОКРУЖАЮЩЕЙ СРЕДЫ

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Отсутствие в нормах по строительной климатологии чётких границ вертикальной климатической зональности горных стран, приводит к погрешностям в сроках выполнения межремонтных работ автомобильных дорог. Приведённые в ГОСТах и других нормативных документах эти сроки носят усредненный характер. По этой причине конструкции дорожных одежд и автотранспортные средства (дорожно-транспортная система) подвергается преждевременному, износу увеличиваются вредные выбросы в окружающую среду горных районов.

С целью увеличения долговечности конструкций дорожных одежд горных автомобильных дорог и снижения вредных выбросов в окружающую среду, предложен метод определения оптимальных сроков межремонтных работ горных автомобильных дорог, с учётом интегрированных показателей их износа, под воздействием природно-климатических факторов горных условий.

Установлено влияние этих факторов на экологическую уязвимость горных районов, даны оптимального сроки снижения межремонтных работ горных автомобильных дорог.

Доказана эффективность математических моделей и достоверность рабочей гипотезы о соразмерности оптимальных сроков снижения межремонтных работ и экологической уязвимости горных районов.

Ключевые слова: горные автомобильные дороги, природно-климатические факторы, вредные выбросы, экологическая уязвимость.

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