JOURNAL OF TRANSPORT

ISSUE 2, 2024 Vol. 1
ISSN: 2181-2438

SLIB.UZ
Scientific library of Uzbekistan

RESEARCH, INNOVATION, RESULTS

TOSHKENT DAVLAT TRANSPORT UNIVERSITETI

Tashkent state transport university

JOURNAL OF TRANSPORT

RESEARCH, INNOVATION, RESULTS

ISSN 2181-2438

VOLUME 1, ISSUE 2

JUNE, 2024

jot.tstu.uz

TASHKENT STATE TRANSPORT UNIVERSITY

JOURNAL OF TRANSPORT

SCIENTIFIC-TECHNICAL AND SCIENTIFIC INNOVATION JOURNAL

VOLUME 1, ISSUE 2 JUNE, 2024

Founder of the scientific and technical journal “Journal of Transport” – Tashkent State Transport University, 100167, Republic of Uzbekistan, Tashkent, Temiryo‘lchilar str., 1, office: 465, e-mail: publication@tstu.uz.

The “Journal of Transport” publishes the most significant results of scientific and applied research carried out in universities of transport profile, as well as other higher educational institutions, research institutes, and centers of the Republic of Uzbekistan and foreign countries.

The journal is published 4 times a year and contains publications in the following main areas:

- Business and Management;
- Economics of Transport;
- Organization of the Transportation Process and Transport Logistics;
- Rolling Stock and Train Traction;
- Infrastructure;
- Research, Design, and Construction of Railways, Highways, and Airfields: Technology and Organization of Construction, Management Problems;
- Water Supply, Sewerage, Construction Systems for Water Protection;
- Technosphere Safety;
- Power Supply, Electric Rolling Stock, Automation and Telemechanics, Radio Engineering and Communications, Electrical Engineering;
- Materials Science and Technology of New Materials;
- Technological Machines and Equipment;
- Geodesy and Geoinformatics;
- Car Service;
- Information Technology and Information Security;
- Air Traffic Control;
- Aircraft Maintenance;
- Traffic Organization;
- Operation of Railways and Roads;

Tashkent State Transport University had the opportunity to publish the scientific-technical and scientific innovation publication “Journal of Transport” based on the Certificate No. 1150 of the Information and Mass Communications Agency under the Administration of the President of the Republic of Uzbekistan. Articles in the journal are published in Uzbek, Russian and English languages.

CONTEXT / MUNDARIJA

Simulation of the process of migration of sand particles through vertical protective barriers

S.T. Djabbarov[1][a], Kh.D. Abdullaev[1][b]
[1]Tashkent state transport university, Tashkent, Uzbekistan

Abstract: This article reflects the results of research on the impact of sandslides on roads, and the results of determining the factors affecting the movement of sand. Also, the results of the modeling of the vertical barriers installed along the road in order to protect the highway from sand drift in the virtual aerodynamic laboratory are presented.
Keywords: sand drift, vertical barriers, solidworks, aerodynamic laboratory.

Qum zarrachalarini vertikal himoya to‘siqlari ustidan ko‘chib o‘tish jarayonini modellashtirish

Djabbarov S.T.[1][a], Abdullayev X.D.[1][b]
[1]Toshkent davlat transport universiteti, Toshkent, O‘zbekiston

Annotatsiya: Ushbu maqolada qum ko‘chkilarini yo‘llarga ta’siri haqida olib borilgan tadqiqotlar tahili, qumlarni ko‘chishiga ta’sir etuvchi omillarni aniqlash natijalari aks etgan. Shuningdek, avtomobil yo‘lini qum ko‘chishidan himoya qilish maqsadida yo‘l bo‘yiga o‘rnatilgan vertikal shakldagi to‘siqlarni virtual aerodinamik laboratoriyada modellashtirish natijalari keltirilgan.
Keywords: qum ko‘chkilari, vertikal to‘siqlar, solidworks, aerodinamik laboratoriya.

1. Kirish

Transport xizmatlariga bo‘lgan ehtiyojning kundan kunga o‘sib borishi zamonaviy talablarga mos keladigan yangi avtomobil yo‘llarini barpo qilishni talab qilmoqda. Bu esa, turli topografik va iqlim zonalaridan o‘tuvchi transkontinental va transmintaqaviy avtomagistrallarni, mavjud avtomobil yo‘llari tarmoqlarini rivojlantirish va takomillashtirish kabi dolzarb muammolarni keltirib chiqarmoqda.

Shunday muammolardan biri bu qumli hududlardagi mavjud hamda yangi loyihalanayotgan yo‘llarni ko‘chki qumlardan saqlash, unda harakatlanayotgan barcha turdagi transport vositalarining xavfsiz va uzluksiz harakatini ta’minlash katta ahamiyat kasb etmoqda. Yo‘l infratuzilmasini takomillashtirish va avtomobil yo‘llari tarmog‘ini jadal rivojlantirish, mamlakatimizning qumli cho‘l hududlaridan o‘tgan 4000 km ga yaqin xalqaro, davlat hamda mahalliy ahamiyatdagi avtomagistrallarini ko‘chuvchan qumlar ta’siridan himoya qilish, har bir yo‘l uchun mahalliy sharoitlarni inobatga olgan holda samarali himoya vositalarni tanlash, innovatsion texnologiyalarga asoslangan texnologik yechimlar ishlab chiqish muhim hisoblanadi [1].

Qumli hududlardagi yo‘llarni qum ko‘chkilaridan himoya qilish bo‘yicha turli usul va vositalarni qo‘llash bo‘yicha L.Bruno, J.Zakeri, L.Rafayele, F.Pellerey, N.Koste, M.Ismoili, Ning Huang, Shuai Zhang, Zhibao Dong, Qingjiye Han, Ke-cun Zhang, Ruiping Zu, Podgornov A.S., Viyesov S.K., Babayev A.G., Petrov M.P., Baynatov J.B., Uteshbayeva A.A., Zokirov R.S., M.Miraxmedov, T.I.Fozilov va boshqalar tomonidan ilmiy-tadqiqot ishlari olib borilgan [2-10].

Aerodinamik laboratoriyada harakatlanuvchi qumlarga qarshi turli shakldagi to‘siqlar ko‘plab olimlar tomonidan modellashtirish yordamida sinab ko‘rilgan va kerakli natijalarga erishilgan[11-17].

Uzoq yillar davomida olib borilgan tadqiqotlarda avtomobil yo‘llarini ko‘chuvchan qumlardan himoya qilishning mexanik usullari, hukmron shamollar yo‘nalishi va tezligini o‘zgarishi, yangi konstruksion yechimlar va innovatsion materiallarni inobatga olgan holda aniq muhandislik va amaliy yechimlari keltirilmagan. Har bir alohida holat (avtomobil yo‘li bo‘lagi) uchun himoya vositalarining uzoq muddat samarali ishlash imkoniyatini beruvchi qurilish-texnologik parametrlarini asoslashda havo-qum massasi harakatini virtual aerodinamik laboratoriyada modellashtirish amaliyoti qo‘llanilmagan.

[a] https://orcid.org/0000-0002-3798-407X
[b] https://orcid.org/0000-0003-0566-3260

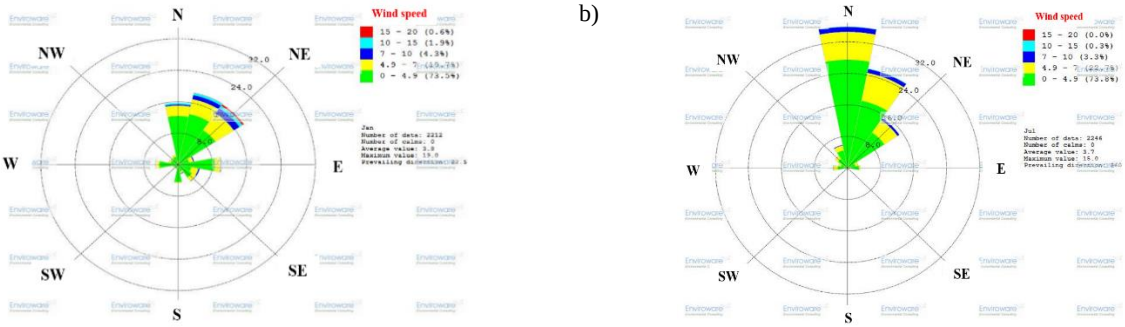
2. Qo‘llanilgan materiallar va uslublar

O‘zbekistonning qumli cho‘l hududlaridan o‘tgan avtomobil yo‘llarida harakat xavfsizligi va yo‘l infratuzilmasi barqarorligiga xavf tug‘diruvchi salbiy holat-qum ko‘chishi bilan bevosita bog‘liq bo‘lgan jiddiy muammoga duch kelmoqda. Ushbu muammolarni hal qilish maqsadida tajriba uchastkasida o‘ziga xos iqlim va tuproq sharoitidan kelib chiqgan holda, yo‘llarni harakatlanuvchi qumlarning ta’siridan himoya qilish uchun vertikal to‘siqlarni o‘rnatgan holda hamda ularni virtual aerodinamik laboratoriyada modellashtirish orqali foydalanishni ko‘rib chiqamiz.

Tajriba uchastkasi avtomobil yo‘lining ma’lum bo‘laklarida qumlarni ko‘chishiga olib keladigan shamolning yo‘nlanishi va tezligini aniqlash maqsadida o‘lchov ishlari amalga oshirildi.

Real vaqt rejimida olingan hamda hududdagi gidrometerologik o‘lchov stansiyalaridan olingan ma’lumotlar qayta ishlanib, hududdagi shamolning yo‘nalishi va tezligi tahlil qilindi. Ushbu ma’lumotlar qayta ishlanib, shamolning tezligi yillar, oylar va yo‘nalishlar kesimida tahlil qilindi. Bu tahlillar yordamida hududda esayotgan hukmron shamollarning yo’nalishi 22.5 gradusga o’zgarganligi aniqlandi (1-rasm).

a) b)



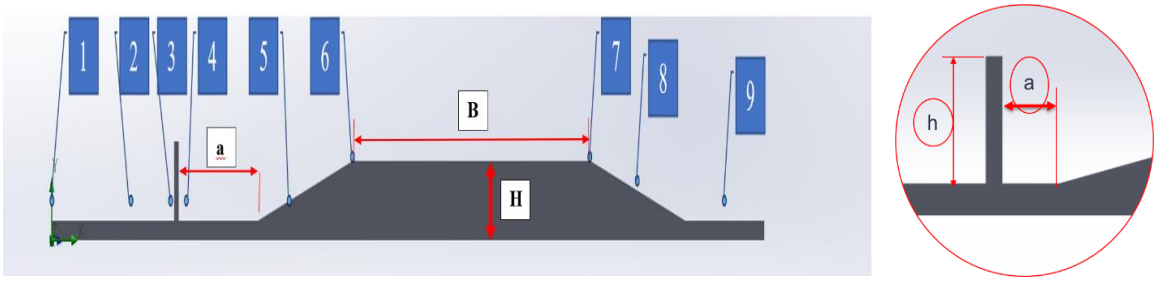
1-rasm. Shamolning “dinamik guli” sxemasi:
a) Yanvar oyi uchun; b) Iyul oyi uchun.

3. Natijalar

Vertikal to‘siqlarni sinab ko‘rish uchun qum yoki chang ko‘p bo‘lgan hududlarga xos bo‘lgan atmosfera sharoitlarini simulyatsiya qilish uchun maxsus vositalardan foydalangan holda bajarish mumkin.

Ushbu maxsus vositalar to‘siqqa yo‘naltirilgan zarrachalar oqimini yaratadigan qum oqimi generatorini o‘z ichiga oladi. To‘siqni sinov uchun boshqariladigan muhitni ta’minlaydigan tunnelga o‘rnatilib sinaladi. Sinov paytida to‘siq shamol, bosim va kuch kabi turli xil yuklarga tekshiriladi.

Yo‘l bo‘ylab havo-qum aralashmasini o‘tkazish jarayonini modellashtirish standart SOLIDWORKS Flow Simulation dasturi yordamida yo‘lning quyidagi parametrlari va himoya tuzilmalarining davriy o‘zgarishi bilan amalga oshirildi (2-rasm).

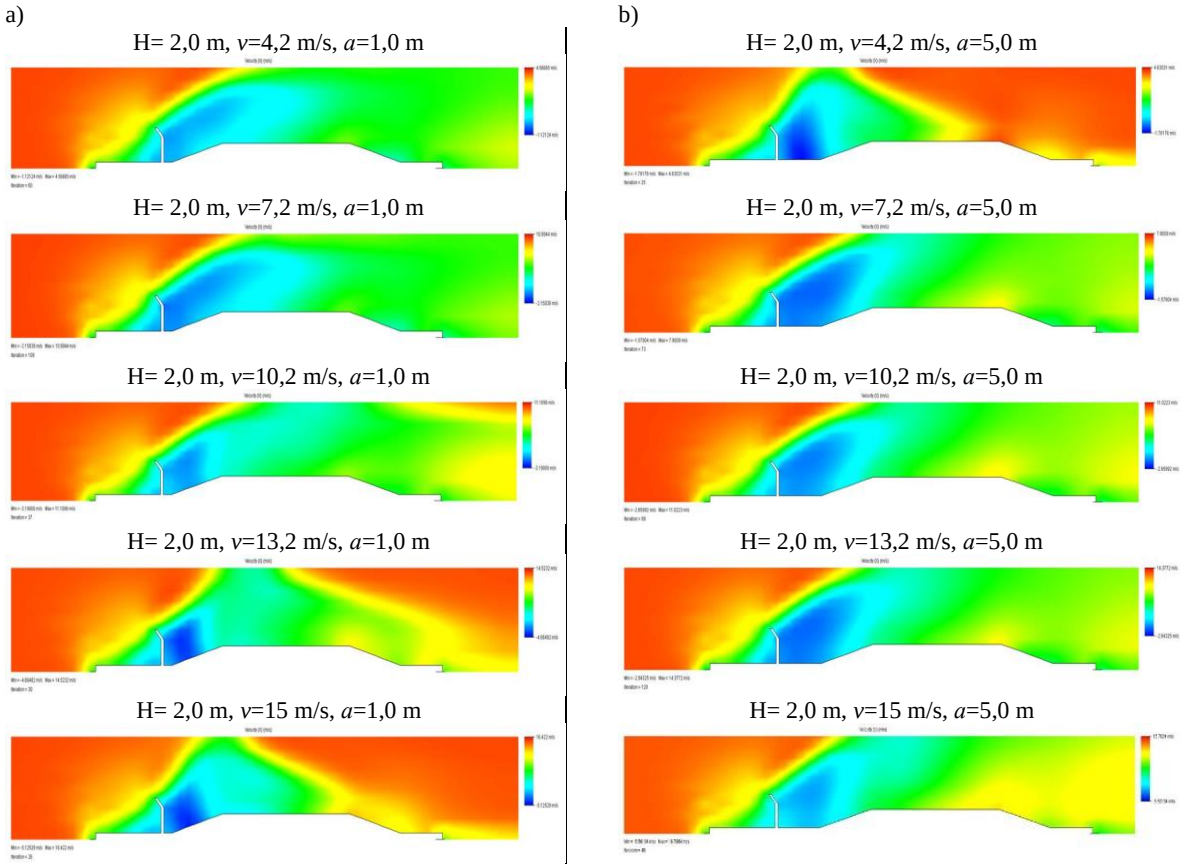


2-rasm. Yo‘l kesimining hamda unda o‘rnatilgan qumdan himoya qiluvchi to‘siqning hisobiy ko‘rinishi:
H - yo‘l ko‘tarmasining balandligi (H=1.5 m); B - yo‘lning eni (B=15.0 m); a - yo‘l poyi ostigan to‘siqgacha bo‘lgan masofa (a=1.0 yoki 5.0 m) h - to‘siq balandligi (h=2,0 m).

Hisob-kitoblarning aniqligini va natijalarning ishonchliligini oshirish uchun dastlabki ma’lumotlarning har bir o‘zgarishi uchun takrorlash soni 100 yoki undan ko‘p marta bo‘lgan. Shamolning yo‘nalishi va shuning uchun havo-qum oqimi yo‘lning o‘qiga perpendikulyar deb taxmin qilingan.

Foydalanilishi kerak bo‘lgan to‘siqning optimal ko‘rinishini aniqlash uchun turli xil havo oqimi tezligi va qum zichligi bo‘yicha sinov o‘tkaziladi. Sinov natijalari to‘siqning konstruksiyasi va materialini inobatga olgan holda uning atmosferada harakatlanuvchi qumlardan himoya qilish samaradorligini yaxshilash uchun qanchalik samarali ekanligi baholanadi.

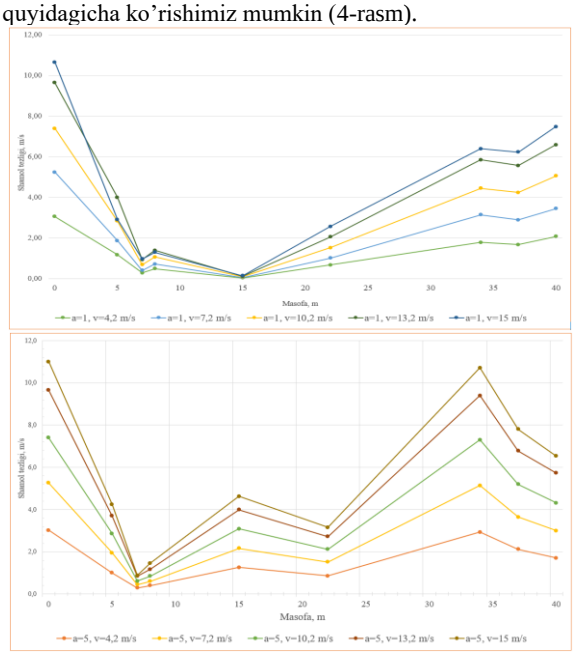
Tadqiqot o‘tkazish davomida vertikal shakldagi to‘siqlarning 2 xil ko‘rinishini maxsus tayyorlangan virtual aerodinamik laboratoriyada modeli hosil qilinib, hududlar uchun turli xarakterli bo‘lgan qiymatlar kiritilib tekshirildi. Ushbu sxemalardagi natijalardan shamol-qum oqimining to‘siq oldida va undan keyin harakatlanish trayektoriyasini tahlil qilish mumkin (3-rasm).



3-rasm. Vertikal to‘siq (devor yoki temir beton konstruksiya) o‘rnatilganda shamol tezligining turli qiymatlarida to‘siq atrofida shamol-qum oqimi o‘zgarishining qirqimda ko‘rinishi

a) a=1 metr bo‘lganda; b) a=5 metr bo‘lganda.

Shuningdek, shamol-qum oqimini nazorat nuqtalari sifatida berilgan nuqtalardagi tezliklarini o’zgarishini quyidagicha ko’rishimiz mumkin (4-rasm).



4-rasm. Vertikal to‘siq (devor yoki temir beton konstruksiya) o‘rnatilganda shamol tezligining turli qiymatlarida to‘siq atrofida shamol-qum oqimi tezligi o‘zgarishi

Havo-qum oqimi tezligi zonasi taqsimotining olingan egri chiziqlari (izoliniyalari) tahlili shuni ko‘rsatadiki:

- havo-qum oqimining yuqori tezlikli zonasini oqimli zamin bo‘ylab taqsimlash himoya strukturasining o‘lchamiga bog‘liq;
- himoya inshooti hajmining oshishi bilan yo‘l tubining chetida havo-qum oqimining tezligi 3,4 m/s dan 8,5 m/s gacha oshadi, bu esa qumni ushlab turmasdan o‘tkazishni osonlashtiradi;
- yo‘l yuzasi bo‘ylab havo-qum oqimining tezligi himoya inshootining o‘lchamlarini 3,8 m/s dan 5,4 m/s gacha oshirish bilan ortadi, bu esa qumning o‘tkazilishiga yordam beradi.

4. Xulosa

Yo‘llarni ko‘chuvchan qumdan himoya qilish uchun vertikal to‘siqlarni modellashtirish tajriba uchastkasida yo‘l harakati xavfsizligini ta’minlashda muhim qadam hisoblanadi. Ishlab chiqilgan modellar keyingi tadqiqotlar va amaliyotga tatbiq etish, tabiiy sharoiti o‘xshash hududlarda infratuzilma muammolarini hal etishda innovatsion yondashuvlarni joriy etish uchun asos bo‘lib xizmat qilmadi.

Ko‘p yillik izlanishlar natijasida cho‘llarda transport vositalarini qum ko‘chishidan himoya qilishning turli uslub va usullari ishlab chiqildi va taklif qilindi. Himoya

usullarining xilma-xilligiga, ushbu usullarning yetarli darajada o‘rganilishiga va ularning natijalarini amaliyotga keng tatbiq etilishiga qaramay, qumli cho‘llarda transport infratuzilmasi obyektlari va inshootlarini qum bosishidan himoya qilishning samarali usuli ishlab chiqilmagan.

Zamonaviy amaliy dasturiy mahsulotlar yordamida amalga oshirilgan hisob-kitoblar natijalari va taqdim etilgan xulosalarni umumlashtirish quyidagi xulosalar chiqarishga imkon beradi:

- yo‘llarni qum ko‘chishidan himoya qilishning mexanik usuli o‘z imkoniyatlarini hali saqlab qolgan;
- himoya vositalarining geometrik o‘lchamlari uning atrofida hosil bo‘ladigan va harakatlanadigan ikkilamchi havo-qum oqimining tezligiga sezilarli ta’sir ko‘rsatadi;
- himoya vositasining qurilish-texnologok parametrlarini kichrayishi oqibatida yo‘l yuzasida cho‘kib qoladigan qum miqdori ortib boradi;

Mahalliy xomashyodan foydalanishga asoslangan samarali va resurslarni tejaydigan, transport infratuzilmasi obyektlari va inshootlarining xavfsiz ishlashini ta’minlash uchun mahalliy xususiyatlarni hisobga olgan holda texnologiyalarni ishlab chiqish dolzarb vazifa bo‘lib qolaveradi. Ushbu maqola qumni siljitishning murakkab muammosini hal qilishga va shunga o‘xshash muammolarga duch kelgan hududlarda yo‘lni muhofaza qilishning moslashtirilgan yechimlarini ishlab chiqishga intilayotgan tadqiqotchilar, siyosatchilar va muhandislar uchun qo‘llanma bo‘lib xizmat qiladi.

Foydalanilgan adabiyotlar / References

[1] Djabbarov, S. and Abdullev, K., “Simulation of process of sand mass transfer over road”, E3S Web of Conferences, 2023, vol. 401. https://doi.org/10.1051/ye3sconf/202340102043.

[2] Maxamadjan Miraxmedov, Azamat Khudoyorov, Khurshid Abdullayev, and Mavjuda Muzaffarova, "Negative impact of wind on the condition of roads (road and rail) in the sandy desert", AIP Conference Proceedings 2432, 030051 (2022) https://doi.org/10.1063/5.0091022

[3] Abdullayev Kh.D. (2022). Modeling the Protection of Highways in the Areas of Moving Sands. International Journal of Current Sciyence Research and Review, 5(10), 3873-3877, https://doi.org/10.47191/ijcsrr/V5-i10-09.

[4] Bruno L., Fransos D., L. Giudice A., 2018a. Solid barriers to control windblown sand: Aerodynamic behavior and conceptual design guidelines. J. Wind, Ind. Aerodin. 173, 79–90. http://dx. doi. org /10.1016/ j. jweia.2017.12.005.

[5] J.A. Zakeri (2012). Investigation on railway track maintenance in sandy-dry areas. Structure and Infrastructure Engineering: maintenance, Management// Life-Cycle Des. Perform., 8 (2012), pp. 135-140. DOI:10.1080/15732470903384921

[6] Raffaele L., Bruno L., 2019. Impact of windblown sand on civil structures: definition and probabilistic modeling. English Structure. 178, 88–101. http://dx.doi.org/10.1016/j.yengstruct.2018.10.017.

[7] L. Bruno, N. Coste, D. Fransos, A.Lo Giudice, L. Preziosi, L. Raffaele / Shield for sand: an innovative barrier for windblown sand mitigation. Recent Patentson Engineering. Vol.12, Issu 3, 2018. p.237-246.

[8] Dong, Z.B., Luo, W.Y., Qian, G.Q., Wang, H.T., 2007. A wind tunnel simulation of the mean velocity fields behind upright porous fences. Agricultural and Forest Meteorology 146 (1-2).

[9] X.M. Wang, C.X. Zhang, E. Hasi, Z.B. Dong (2010). Has the Three Norths Forest Shelterbelt Program solved the desertification and dust storm problems in arid and semiarid China// J. Arid Environ., 74 (2010), pp. 13-22, DOI: 10.1016/j.jaridenv.2009.08.001

[10] YU Qiu, I.B., Leye, H., Shimizu, Y. Gao, G. Ding (2004). Principles of sand dune fixation with straw checkerboard technology and its effects on the environment/ J. Arid Environ., 56 (2004), pp. 449-464, 10.1016/S0140-1963(03)00066-1GCC Transport and Railway Conference, Doha, Qatar (2011), pp. 17-19.

[11] Yin tang, L.; Yi, G. Numerical modeling of aeolian silty sand transport in a marginal desert region during the early stage of entrainment. Geomorphology 2008, 100, 335–344.

[12] S. Xie, J. Qu, Y. Pang (2017) Dynamic wind differences in the formation of sand hazards at high- and a Slow altitude railway sections/ J. Wind Eng. Industrial Aerodynamics, 169 (2017), pp. 39-46. DOI: 10.1016/j.jweia.2017.07.003

[13] He, W.; Huang, N.; Xu, B.; Wang, W. Numerical simulation of wind-sand movement in the reversed flow region of a sand dune with a bridge built downstream. Eur. Phys. J. E 2018.

[14] Xin, G.; Huang, N.; Zhang, J.; Dong, H. Research on the design of sand barriers for buildings in the Gobi. Aeolian Res. 2021.49, 100662.

[15] Xie, S.; Qu, J.; Zhang, K.; Khan, K.; Pang, Y. Damage mechanism of sand in the Fushaliang section of Liuyuan-Golmud Expressway. Aeolian Res. 2021, 48, 100648.

[16] Li, S.; Li, K.; Yao, D.; Ge, H.; Zhang G. Wind tunnel experiments for dynamic modeling and analysis of wind-blown sand trajectories. Euro.Phys. JE2020, 43, 22.

[17] Shi, L.; Jiang, F.; Han, F. Numerical modeling of the reaction law of sand wind flow around a railway embankment. Tiedao Xuebao/J. Chinese Railway. Social 2014, 36, 82–87.

Mualliflar bo‘yicha ma’lumot/ Information about the authors

Saidburkhan Djabbarov / Djabbarov Saidburxan Tulaganovich	Toshkent davlat transport universiteti, texnika fanlari doktori, professor. e-mail: _saidhon_@inbox.ru tel.: +998901852934 ORCID: https://orcid.org/0000-0002-3798-407X
Khurshidbek Abdullaev / Abdullayev Xurshidbek Dilshodbek o‘g‘li	Toshkent davlat transport universiteti, texnika fanlari bo‘yicha falsafa doktori (PhD). email: Mr.Khurshidbek93@mail.ru tel.: +998909700067 ORCID: https://orcid.org/0000-0003-0566-3260