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RESEARCH, INNOVATION, RESULTS



**TOSHKENT DAVLAT  
TRANSPORT UNIVERSITETI**

Tashkent state  
transport university



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# TASHKENT STATE TRANSPORT UNIVERSITY

## JOURNAL OF TRANSPORT

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Articles are published in Uzbek, Russian, and English, ensuring a wide-reaching audience and fostering cross-cultural academic exchange. As a beacon of academic excellence, the "Journal of Transport" continues to serve as a vital conduit for knowledge dissemination, collaboration, and innovation in the transport sector and related fields.

## Development of the result of geodetic measurements and forecasting accidental movements

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**Abstract:** In the article, based on the results of observations of the landslide site of the studied territory using GPS receivers, the sequence of data processing in the software, i.e., the preliminary and final processing procedure, was considered, and landslide movement was predicted.

**Keywords:** landslide site, relief, hazardous geological processes, base points, triangulation points, programs, spatial GPS network, state geodetic network, support network points, office work

## Geodezik o'lchashlar natijasini ishlab chiqish va ko'chki siljishlarini bashorat qilish

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**Annotatsiya:** Maqolada, o'rganilayotgan xududning GPS qabul qilgichlar yordamida ko'chki uchastkasida kuzatuv ishlari natijasi asosida ma'lumotlarni dasturiy ta'minotda qayta ishlash ketmaketligi ya'ni dastlabki hamda yakuniy ishlab chiqish tartibi ko'rib chiqish asosida ko'chki surilishi bashorat qilingan.

**Kalit so'zlar:** ko'chki uchastkasi, relef, xavfli geologik jarayonlar, asos punktlar, triangulyatsiya punktlari, dasturlar, fazoviy GPS – tarmoq, davlat geodezik tarmoq, tayanch tarmoqlari punktlari, kameral ishlar

### 1. Kirish

Ko'chki uchastkasi qismida tayanch geodezik tarmoq punktlarini koordinatalarini GPS sistemasi yordamida aniqlash maqsadida kuzatishlar olib borilgan.

Ushbu obyektida bajarilgan o'lchash natijalarini kameral qayta ishlash dastlabki hisoblashlar va geodezik tarmoqlarni tenglashtirish kabi bosqichini o'z ichiga oladi. Dastlabki hisoblashlarda tarmoqning kuzatish punktlari oralig'idagi bazis chiziqlari – vektorlari hisoblanadi. Vektorlarning hisoblanishi pretsizion efemerid yo'ldoshlar ma'lumotlaridan foydalanilgan holatda amalga oshiriladi, bu holat tarmoqning geometrik ko'rsatkichlarini aniqlashda ishonchlilik va aniqlik darajasining sezilarli darajada o'rtishini ta'minlaydi.

Ortiqcha o'lchashlar ma'lumotlarining mavjudligi tarmoqning bitta vektori bo'yicha bir nechta variantlarda hisoblashlarni amalga oshirish imkonini beradi va natijada esa hisoblash ishlari sifati ortadi.

Kameral ishlarning sifatini nazorat qilishda ushbu qayta ishlash bosqichida vektorlar bo'yicha bir qator nazorat hisoblanishlarni bajarish talab qilinadi, bunda vektorlarni aniqlash va yopiq geometrik shakllardagi bog'lanmaslik holatlari e'tiborga olinadi. Vektorlarni hisoblashda turli xildagi dasturiy ta'minotlardan foydalanilish mumkin, jumladan, SKI Pro, «Trimble Navigation», Bernese va Gamit firmalari tomonidan ishlab chiqarilgan GPS Survey va TG Office dasturlaridan tarmoqlar gorizontal hamda vertikal siljishlarini aniqlashda natijalarni ishlab chiqish uchun keng foydalaniladi.

### 2. Tadqiqot metodologiyasi

Turli xil dasturlardan foydalanishda ishlab chiqish natijalari orasida sezilarli jiddiy farqlanishlar kuzatilmaydi. Bir nechta hisoblangan vektorlar bitta bo'lib matematik ellipsoid sirtidagi fazoviy GPS – tarmoqni tashkil qiladi. Qo'yilgan maqsadga bog'liq holatda bu tarmoq turli xil usullar yordamida tenglashtiriladi va bunda turli koordinatalar sistemalaridan foydalaniladi. Agar kuzatish bekatni yangidan o'rnatilgan reperlarda joylashtirilgan bo'lib, boshlang'ich koordinatalari noma'lum bo'lsa tayanch tarmoq shartli koordinatalar sistemasida mustaqil holatda tenglashtiriladi, natijada chiziqlar uzunligi va tarmoq punktlari orasidagi nisbiy balandliklar aniqlanadi.

Kuzatish punktlari sifatida davlat geodezik tarmoq va tayanch tarmoqlari punktlari foydalanilsa masala birmuncha murakkablashadi, biroq yuqorida qayd etilganidek ushbu masalaning ijobiy hal qilishda bir qator mualliflik paketlaridan foydalanish samarali natijalarga olib keladi.

Obyekt misolida ko'rib chiqilayotgan hududda GPS kuzatishlar natijalari quyidagi bosqichlarda ishlab chiqiladi:

- sun'iy yo'ldosh o'lchashlarini dastlabki ishlab chiqish;
- GPS o'lchash natijalari aniqligini baholash.

**Dastlabki ishlab chiqish.** Sun'iy yo'ldosh o'lchashlarni dastlabki ishlab chiqishdan asosiy maqsad – vektorlar qiymatini olish va ularni o'rnatilgan talab aniqligiga muvofiqligini nazorat qilish hisoblanadi va u quyidagi tartibda amalga oshiriladi: Leica Geo Office Combined (Shveysariya) dasturi (maxsus Leica qabul qilgichlari uchun mo'ljallangan) yordamida GPS qabul qilgichdagi ma'lumotlar kompyuter xotirasiga yuklanadi va uni natijaviy

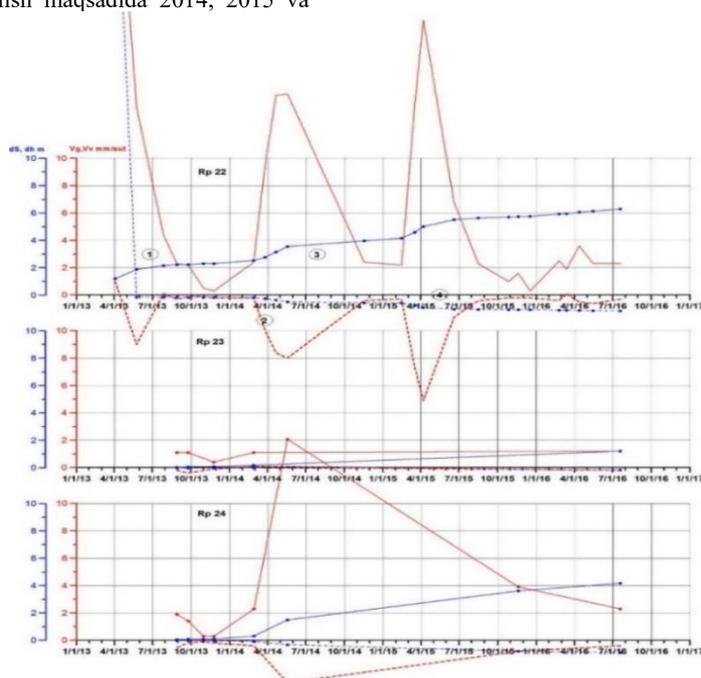
<sup>a</sup> <https://orcid.org/0000-0002-8481-3281>





Kuzatishlar davrida nazorat reperlarni joylashish chizmasi o'zgarmadi, turli reperlar ustida amalga oshirilgan o'lchovlar soni esa har xil bo'ldi. Ko'chki massalarining siljish natijalarini tahlil qilish maqsadida 2014, 2015 va

2016-yillar kuzatish davri uchun gorizontol va vertikal siljishlar tezligi va qiymati bo'yicha tuzilgan grafigi quyidagi chizmada beriladi.



4 – rasm. Naugarzan ko'chki uchastkasidagi 2013-2016-yillar uchun Rp 22,23,24 bo'yicha gorizontol (1), vertikal (2) va umumiy siljishlar (3,4) tezliklarining o'zgarishi grafigi berilgan

Geodezik o'lchash natijalarining tahliliga ko'ra, rivojlanish mexanizmida uchta zona ajratiladi: quyi, o'rta va yuqori. Ko'chki rivojlanishining dastlabki yillarida maksimal siljishlar quyi, keyinroq o'rta va yuqori zonalarda kuzatildi, ya'ni ko'chki pastdan yuqoriga qarab rivojlanib borgan, ko'chish tezligi 37-67 mm/sutkaga yetgan. Umuman olganda, gorizontol ko'chish qiymati 1995-yildan 2014-2016-yillargacha 14,8 mertdan yiliga urtacha 0.3-1.0 metrgacha tushgan. Ko'chish qiymati kamayishining bunday tendensiyasi so'nggi 8-10-yil davomida qayd etilmoqda.

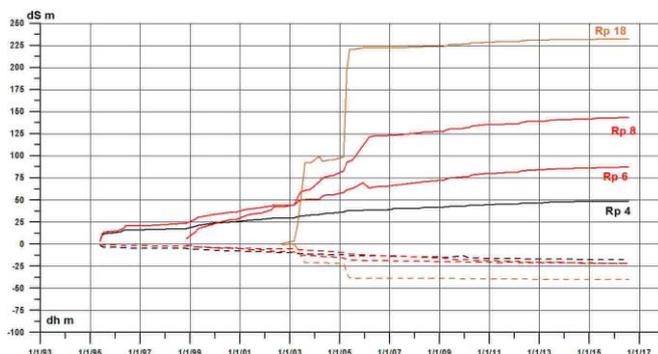
So'nggi 2014-2016-yillar yuqori zonada (Rp 22) yer gorizontol siljishi 1,1-1,2 m, o'rta zonada (Rp 24) 2,7 dan 4,0 metrgacha, pastki zonada esa (Rp 23) 0.4-0.8 metrni tashkil qildi. Bu esa ko'chish tezligini quyi zonada maksimal kamayishini va o'rta zonada siljish eng aktiv bo'lganligini bildiradi.

Ushbu o'lchash natijalari yillar bo'yicha solishtirib tahlil qilinadi va bu 2-jadvalda keltirib o'tilgan.

2-jadval

No Rp	1995	1995-2014	1993-2004	2005-2014	2012	2013	2014	2015	2016
Rp 4	12,9	47,9	35,5	12,4	1,0	0,5	0,2	0,6	0,1
Rp 6	14,8	85,7	56,4	21,1	2,4	0,87	0,41	0,7	0,2
Rp 8H	19,0	141,5	77,8	63,7	2,5	1,3	0,8	1,2	0,0
Rp 18	16,0	231,5	95,5	136	1,6	0,4	0,02	0,2	0,4

Qo'yidagi olingan kuzatish natijalari 5 – rasmda grafik ko'rinishda keltirib o'tilgan.



5 – rasm Ko'chki uchastkasining 1995 – 2016-yillar uchun Rp4, 6, 8 bo'yicha umumiy va gorizontol ko'chishlar qiymatlarining o'zgarish grafigi



### 3. Xulosa

Ko'chki uchastkasining rivojlanish mexanizmi bo'yicha harakatning davriy qaytarilish o'ziga xos tabiatiga ega, ya'ni maksimal siljishlar namgarchilik yuqori bo'lgan bahor oylarida sodir bo'ladi. O'tgan yillardagi kabi, reperlarning asosiy siljish vektorlari shimoli - g'arbga, tomonga yo'nalgan.

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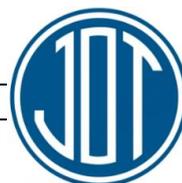
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