Date of Submission	18 July 2025

IPL Project (IPL-Number) Annual Report Form

Period of activity under report
from 1 January 2024 to 31 December 2024

1. **Project Number and Title:**

IPL-238 Landslides Threatening Russian Cultural Heritage Sites

2. **Main Project Fields**

(2) Targeted Landslides: Mechanisms and Impacts

B. Landslides Threatening Heritage Sites

(3) Capacity Building

B. Collating and Disseminating Information/ Knowledge

3. **Name of Project Leader**

Gorobtsov Denis N.

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Core members of the Project

Igor Fomenko – Ph.D., professor of Department of Engineering geology, Russian State geological Prospecting University;

Daria Shubina – master, Senior Lecturer of Department of Engineering geology, Russian State geological Prospecting University;

Margarita Novgorodova – master, Lecturer of Department of Engineering geology, Russian State geological Prospecting University.

4. Objectives: Development and approbation of the landslides modeling methodology within historical natural-technical systems.

5. Study Area: different objects of Russian cultural heritage, including UNESCO cultural heritage sites.

6. Project Duration: 4 years

7. Report

1) Progress of the project:

In 2024, the authors of this study participated in several large-scale projects related to the

study of landslides, including on the territory of cultural heritage sites.

1. METHODOLOGY FOR CONDUCTING AN EXTENDED PSEUDOSTATIC ANALYSIS OF SLOPE STABILITY (USING THE EXAMPLE OF THE LAZOVAYA RIVER LANDSLIDE, SAKHALIN)

2. EXTENDED PSEUDOSTATIC ANALYSIS OF SLOPE STABILITY (USING THE EXAMPLE OF A LANDSLIDE ON THE LAZOVAYA RIVER, SAKHALIN ISLAND)

3. CONDITIONS OF FORMATION OF LARGE ROCK LANDSLIDES IN LIMESTONE DAGESTAN ON THE EXAMPLE OF THE KAKHA LANDSLIDE

4. ASSESSMENT OF THE LANDSLIDE SUSCEPTIBILITY OF THE NUREK REGION OF TAJIKISTAN AND ADJACENT TERRITORIES

5. ASSESSMENT OF LANDSLIDE HAZARD USING THE FREQUENCY RATIO METHOD AND THE COMBINED FRACTAL-FREQUENCY METHOD USING THE EXAMPLE OF TINH TUK CITY, CAOBANG PROVINCE (VIETNAM)

I.K. Fomenko and D.N. Gorobtsov also participated in the following conferences:

XVII International Scientific and Practical Conference "New Ideas in Earth Sciences" April 3-4, 2025, Moscow:

1. Application of the RMR classification and the finite element method to analyze the stability of the Rogun HPP tunnel.

2. The methodology for conducting an extended pseudostatic analysis of slope stability (using the example of the Lazovaya River landslide, Sakhalin).

3. The dangers of underwater landslides in the Northern Caspian Sea: A threat to infrastructure and ecosystem.

4. Analysis of the influence of engineering and geological conditions on the development of deformations of architectural monuments in Staritsa, Tver region.

The research team managed to effectively implement the tasks of expanding the database on landslide processes in significant historical sites. The collected materials will help to build an integrated system of knowledge about the nature of landslide development in the context of historical natural and technical complexes.

2) Planned Future Actions or Project Completion Statement

In the coming 2025, the scientific community will continue an in-depth study of landslide phenomena in the area of cultural and historical monuments.

The scientific program provides for extensive work in several key areas:

- Systematization and analysis of existing data
- Development of innovative surveillance techniques
- Creation of modern forecasting systems
- Implementation of advanced monitoring technologies

A priority area of research will be a detailed study of historical complexes where natural and technical systems are at potential risk. Scientists will focus on analyzing the mechanisms of the origin of landslides, studying the patterns of their development, identifying critical risk factors, and assessing vulnerable areas.

The practical significance of the project lies in the formation of a comprehensive system for the protection of cultural heritage. Based on the data obtained, preventive measures and early warning methods will be developed.

The result of the research will be the creation of an effective system for protecting cultural and historical sites from the negative effects of landslide processes, which will preserve the unique heritage for future generations. As part of this work, active cooperation with experts in the field of archeology, geology and other related sciences is envisaged.

The project provides for the comprehensive development of the professional potential of specialists: a series of training seminars for experts on the preservation of cultural heritage is organized, which will ensure their professional development and exchange of practical experience, and participation in scientific conferences will provide an opportunity to present research results to the professional community, receive expert assessment and outline promising areas for further work.

It is expected that the research results of 2024 will become an important contribution to the development of scientific knowledge about landslides and will help preserve unique cultural heritage sites for future generations.

1) Project beneficiaries for science, education and/or society: Ministry of Culture of the Russian Federation, Russian Orthodox Church, UNESCO

2) Results: Modeling and assessment of the stability of landslides of various types and scales, instrumental monitoring. Performing a local landslide hazard assessment using Scoops3D. Application of GIS-based statistical methods to assess the potential development of landslides. Landslides are regionally located: Sparrow Hills, Moscow; Moscow region; Crimea; Mzymta River Valley, Sochi Region, Russia; Chung Chai commune (Sha Pa, Vietnam); Nurek district, Tajikistan.

In addition, researchers led by A.L. Strom are participating in the Russian Science Foundation grant No. 25-47-00020 on the topic: «The mechanism of formation of landslides caused by strong earthquakes and the assessment of the danger caused by them in tectonically active regions of China and Russia».

In the reporting period, key tasks related to the investigation of the landslide massif in the area of the metro bridge on the territory of the Kolomenskoye Museum-Reserve were successfully implemented. Comprehensive surveys have been carried out, including geophysical monitoring and assessment of slope stability. Work continues on Dagestani historical sites, in particular, on the ancient fortress, which was studied under the grant. Specialists perform a detailed analysis of the

condition of structures and assess the risks of their destruction. In parallel, calculations are being carried out on the destruction of granite massifs of the "Wedge" type in Karelia, which makes it possible to improve methods for predicting deformation processes in rocks.

Currently, the monitoring of landslide processes on Vorobyovy Gory continues using modern instrumental observation methods. Specialists regularly carry out measurements and analysis of the data obtained to adjust protective measures. Special attention is paid to the development of new approaches to forecasting the development of dangerous geological processes at cultural heritage sites. It is planned to expand the geography of research to include additional sites that require detailed study and protection from natural influences.