Geophysical Research Abstracts,
Vol. 11, EGU2009-10215, 2009
EGU General Assembly 2009

Mechanical-mathematical modeling for landslide process

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Landslides process is one of the most widespread and dangerous processes in the urbanized territories. In Moscow the landslips occupy about 3 % of the most valuable territory of city. There are near 20 places of deep landslides and some hundreds of shallow landslides in Moscow. In Russia many towns are located near rivers on high coastal sides. There are many churches and historical buildings on high costs of Volga River and Moscow River. The organization of monitoring is necessary for maintenance of normal functioning of city infrastructure in a coastal zone and duly realization of effective protective actions. Last years the landslide process activization took place in Moscow.

The right coast of river Moscow on its significant extent within the limits of city Moscow is struck by deep block landslides with depth up to 90 - 100 m which formation occurred in preglacial time with basis of sliding in Callovian-Oxford clays of Jurassic system on 25 - 30 m below modern level of the river .

One of landslide sites is on Vorob'evy mountains, on a high slope of the right coast of the river Moscow with height of 65 m.

There is a historical monument - «Andreevsky monastery», based in 1648. Also there are the complex of buildings of Presidium of the Russian Academy of Sciences, constructed in 70 - 80th years of 20-th century, bridge with station of underground "Vorob'evy mountain", constructions of sport complexes. Landslide slope is in active condition, and there are many attributes of activization of deep block landslide.

In June 2007 a rather big landslide took place there near ski-jump.

Another landslide site is in a southeast part of Moscow, occupying the right coast of river Moscow near museum - reserve "Kolomenskoye". The slope in this place has height of 38 - 40 m. Motions of deep landslips have begun from 1960 in connection with construction of collectors. In 70th years of XX century there was a strong activization of a slope with formation of cracks by extent up to 500 m and displacement of a landslide in the plan over 1 m. Last serious activization of a landslide has taken place in 2002 with a motion on 53 cm.

Catastrophic activization of the deep blockglide landslide in the area of Khoroshevo in Moscow took place in 2006-2007. A crack of 330 m long appeared in the old sliding circus, along which a new 220 m long creeping block was separated from the plateau and began sinking with a displaced surface of the plateau reaching to 12 m. Such activization of the landslide process was not observed in Moscow since mid XIX century. The sliding area of Khoroshevo was stable during long time without manifestations of activity.

Revealing of the reasons of deformation and development of ways of protection from deep landslide motions is extremely actual and difficult problem which decision is necessary for preservation of valuable historical monuments and modern city constructions. The reasons of activization and protective measures are discussed. Structure of monitoring system for urban territories is elaborated.

Mechanical-mathematical model of high viscous fluid was used for modeling of matter behavior on landslide slopes. Equation of continuity and an approximated equation of the Navier-Stockes for slow motions in a thin layer were used. The results of modelling give possibility to define the place of highest velocity on landslide surface, which could be the best place for monitoring post position. Model can be used for calibration of monitoring equipment and gives possibility to investigate some fundamental aspects of matter movement on landslide slope.