Risk assessment methodology applied to highway RJ 155 in Angra dos Reis

Metodologia de avaliação de risco aplicada à rodovia RJ 155 em Angra dos Reis

F. J. Pires

W. L. Silva

P. F. Magalhães

S.C. Moura

V.C. Neves

M.S. Oliveira

ABSTRACT
The State of Rio de Janeiro enchants everyone by the beauty and landscape diversity, because it is possible to be close to the Serra and the Sea, however the sudden drop of relief works as a physical bulkhead for the entrance of cold fronts coming from the Atlantic Ocean, which culminate in the formation of heavy rains. Such conditions, added to geology, geomorphology, population density, the constructive profile of buildings, socio-environmental vulnerability and anthropic actions, can trigger mass movements with great destructive power. The increase in recurrences and concentration of rainfall has been increasingly catastrophic, requiring the adoption of technical and management measures that are increasingly fast and effective. In April 2022, the state of Rio de Janeiro faced a serious disaster in the south of the state, being decreed an Emergency Situation in the municipality of Angra dos Reis (Decree 12553/2022 of 02/04/2022).

Keywords: Risk, Highway, Geological.

RESUMO
O Estado do Rio de Janeiro encanta a todos pela beleza e diversidade paisagística, pois é possível estar próximo da Serra e do Mar, entretanto a queda brusca de relevo funciona como um anteparo físico para a entrada de frentes frias advinda pelo oceano Atlântico, que culminam na formação de fortes chuvas. Tais condições somadas à geologia, geomorfologia, o adensamento populacional, o perfil construtivo das edificações, a vulnerabilidade socioambiental e ações antrópicas, podem deflagrar movimentações de massa com grande poder destrutivo. O aumento nas recorrências e concentração das chuvas vem sendo cada vez mais catastróficas, exigindo a adoção de medidas técnicas e de gestão cada vez mais rápidas e eficazes. Em abril de 2022, o estado do Rio de Janeiro enfrentou um grave desastre no sul do estado, sendo decretada Situação de Emergência no município de Angra dos Reis (Decreto 12553/2022 de 02/04/2022).

Palavras-chave: Risco, Rodovia, Geológico.

1 INTRODUCTION

The State of Rio de Janeiro enchants everyone by the beauty and landscape diversity, because it is possible to be close to the Serra and the Sea, however the sudden drop of relief works as a physical bulkhead for the entrance of cold fronts coming from the Atlantic Ocean, which culminate in the formation of heavy

rains. Such conditions, added to geology, geomorphology, population density, the constructive profile of buildings, socio-environmental vulnerability and anthropic actions, can trigger mass movements with great destructive power. The increase in recurrences and concentration of rainfall has been increasingly catastrophic, requiring the adoption of technical and management measures that are increasingly fast and effective. In April 2022, the state of Rio de Janeiro faced a serious disaster in the south of the state, being decreed an Emergency Situation in the municipality of Angra dos Reis (Decree 12553/2022 of 02/04/2022).

In April, after a period of intense rains, the South Fluminense Coast recorded successive landslides. The affected areas were mostly composed of hills and steep slopes and with little population density, reducing the power of destruction of the event, but endangering the cars that circulate along Highway 155.

In order to expedite the service and provision of services to the population in situations of danger, a methodology for identifying the geological event that reduces the time of the risk assessment procedure was developed by the technicians of the Department of Engineering (DEPEN) of the Civil Defense.

2 GOAL

This work aims to disseminate the methodology used in the mapping of the areas of geological risk on the highway, the results obtained with the assessments of the risk areas that were elaborated in the municipality, in attention to the guidelines established by the National Policy of Protection and Civil Defense (PNPDEC), instituted by Federal Law 12.608/2012, and consisted in the identification and characterization of the portions on the highway of the places with high potential to be, or who have been affected by adverse events of a geological nature.

3 METHODOLOGY

The work was carried out based on Law 12,608 of 2012 that deals with the National Plan for Risk and Disaster Management in Brazil and the analysis and delimitation of the geological risk of an area affected by landslides occurs immediately after the outbreak of mass movements. The geological processes analyzed in this emergency phase are classified according to the Brazilian Disaster Coding (COBRADE), which represents the standardization of occurrence records, facilitating the identification of disasters in Brazil.

Thus, considering the limits of the technicians' performance, the processes related to the geological group and the identified mass movements subgroup are analyzed. It precedes the field, the investigation of past events registered in the DEPEN database and photointerpretation of the slope.

In the field, the type of mass movement is identified: falling, tipping or rolling; type of landslide: soil or rock; mass racing; subsidence or erosion; and crawl (AUGUSTO-FILHO, 1992). After the identification of the process, the movement, its geometry and material are characterized. The analysis is

made based on the observation of the unstable features and expressive indicators in the stage of development, the preferred path of natural drainages, in addition to evaluating the speed according to the material and the radius of reach of what can be mobilized and what can be achieved: building or highway, by mass movement, if the process is activated, and if there is any construction work to mitigate the risk.

4 DEVELOPMENT

The aspects evaluated for classification of the average risk are slope of the slope, height, type of terrain, incipience of step of abatement, establishment of cracks in the soil, exposed blocks, types of rigid structures present, where the processes in full development are verified, which indicate high potential of landslides, but it is possible to monitor their evolution.

The classification for high risk indicates signs installed such as cracks in the ground, abatements on slopes, cracks in dwellings or retaining walls, trees or sloping poles, slip scars, erosive features such as ravines or gullies, proximity to the highway, among others. These are present expressively and in large numbers or magnitude, and the process of instability is in an advanced stage of evolution. It is the most critical condition, being unlikely to monitor its evolution, given its high stage. Maintaining existing conditions, destructive events are expected to occur during episodes of intense and prolonged rainfall.

At the end of the in situ evaluation and with the *information observed in the field, reports of occurrences are prepared with the description of mapped areas, classified according to the degree of risk and updating of the georeferenced maps, indicating the areas with potential and/or installed risk.*

The points classified as medium risk indicate the need for preventive measures to mitigate the action of geological events, always accompanied by constant monitoring and with the application of restrictions for the use and occupation of the land in these stretches and, with this, create a reduction of the risk. Already the points with high risk are necessary stricter measures imposed, in such a way that will guarantee the safety of those who travel the highway or reside in these places, being necessary the interdiction, always aiming at the preservation of life.

5 FINAL CONSIDERATIONS

This highway is of paramount importance for the entire South Fluminense region, since it is the main link between Barra Mansa and Volta Redonda with Angra dos Reis and Paraty, being the main access road to the municipality of Rio Claro.

Considering the need to implement the actions provided for in the PNPDEC, the methodology applied to the risk produced satisfactory results such as the implementation of preventive and more direct actions to the adverse event, the management of mitigation, response and recovery actions, promoting a

better performance of protection and Civil Defense actions. The direction of the actions carried out by the technicians allows the acquired material to serve as a basis for actions of public managers.

Because it deals with an expeditious methodology, it is limited to an evaluation addressing classification, characteristics, causes and types of landslides, not providing information that allows the elaboration of containment projects, requiring more detailed investigations for the feasibility of containment projects and stabilization of slopes by geotechnical specialists.

REFERENCES

ANGRA DOS REIS, 2022. Decreto n° 12.553, de 02 de abril de 2022.

AUGUSTO FILHO, O. 1992. Investigações e Análises/Coleção Manual Técnico de Encostas. 2 ed. Rio de Janeiro: GEO-RIO, 2000, v. 1 p. 71.

BRASIL. lei nº 12.608, de 10 de abril de 2012. Política Nacional de Proteção e Defesa Civil - PNPDEC. Diário Oficial da Republica Federativa do Brasil, Brasília, DF, nº 70, de 11 de abril de 2012. Disponível em: < http://www.planalto.gov.br/ccivil_03/_Ato2011-2014/2012/Lei/L12608>. Acesso em: 30 maio 2023.