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Rockfall hazard analysis in Deccan Plateau: A case study from Malshej Ghat, Maharashtra, India

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Due to the high velocity movement of blocks, rockfalls are one of the most dangerous natural hazards in the steep and cliff slopes of the Deccan Plateau and frequently represent the main threat to the anthropogenic setting, potentially damaging urban areas, roads and highways. This work illustrates a case study of rockfall hazards in Malshej Ghat, Maharashtra, India. Owing to its importance as a popular tourist destination and an important communication route (NH-222) that is vulnerable to landslide hazard, serious risks are posed during the monsoon period. Several fatal accidents causing deaths and serious injuries due to landslides (mainly rockfall) were reported from Malshej Ghat (Fig. 1).

Malshej Ghat is covered by a series of peaks comprising several basaltic lava flows of Deccan Trap with the thickness of individual flows varying from a few to several metres (Fig. 2a). These flows are mostly horizontal and form flat topped hills with step-like terraces produced from differential weathering and erosion (Fig. 2b). The rockfall problem can be related to high pore water pressures generated during percolation of rain water along joints/fractures during prolonged rainfall, differential weathering, root growth or leverage by the roots of vegetation moving in high winds, erosion and slope unloading and progressive opening of joints or a combination (Fig. 1, 2a and b).

Figure 1: Major rockfall incidences occurred during the monsoon in 1996, 2013 and 2015 along Malshej Ghat section of NH-222, Maharashtra, India

Figure 2: (a) Fracture zones cutting across basaltic lava flows and controlling development of a linear, deep valley in Malshej Ghat area, (b) slope profile at 2013 rockfall site

The study included geomechanical and kinematic characterization of the rockmass, identification of potential zones of failure and rockfall trajectory modelling. Further, the rockfall trajectories along the slope were modelled using a 2D program for rockfall analysis. This study provides information about trajectory path and the rockfall bounce height and other rockfall parameters namely kinetic energy and translational velocity. It was observed that the higher the initiation zone of falling blocks, the higher is the bounce height of the blocks assuming constant weight of the blocks. It was also observed that the falling block trajectory

depends on the geometry of the slope (Fig. 2b) and the initiation zone of the falling block. Blocks falling from greater heights above the road often crossed the road without contact with it and on the other hand, when the point seeder was positioned at lower heights above the road, the rocks fell directly on the road. The computed bounce height, kinetic energy and translational velocity as well as rockfall trajectory for different slopes should be considered to design barriers. The trajectory is helpful for deciding the position of barrier. The bounce height, kinetic energy and translational velocity are useful in determining the strength and height of the barrier. These analyses aid in building effective barriers and/or rock catch areas for mitigation of rockfall hazards in protection of NH-222 in Malshej Ghat.