SLOPE INSTABILITY HAZARDS IN GRANITES OF THE LESSER HIMALAYAN EXAMPLE OF THE PALUNG GRANITE OF CENTRAL NEPAL

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Granites are hard and sound rock at relatively fresh or unweathered condition. Steep rocky slopes are the characteristic features in the area occupied by granites of the Lesser Himalaya including Kathmandu nappe. Almost vertical to sometimes overhanging slopes in granites look stable in dry season, but the steeper slopes in the areas occupied by granitic rocks are metastable to unstable. The instabilities are related to: variation in texture and mineral composition of granite, nature and intensity of weathering (mechanical and chemical), altitude of the area, orientation of natural slope with reference to the predominant joint sets, quality of rock mass, stress release and activity of subsurface water during monsoon. The study is supposed to be an example for the study of the slope instabilities in the other part of the Himalaya occupied by granitic bodies.

Palung Granite massif is one of the six granitic bodies situated within the Mahabharat range of Central Nepal. The massif itself runs WNW—ESE, pinches gradually in the west. It

has sharp contact to the surrounding rocks. The massif has been recognized as a multiphase intrusive containing a number of facies (Sharma, 1982). The facies of the massif varies from coarse grained inequigranular porphyritic tourmaline granites in the central part and inequigranular tourmaline granites with portions of microperthite texture towards periphery.

Medium (0.2 m) to very wide (>3 m) spaced four sets of joints are common in the Palung massif. Among the four sets one set is almost parallel to the foliation of the country rock, two sets are preferred joints and the fourth sets are randomly oriented. The attitudes (dip/dip direction) of foliation parallel joints (J1) are mainly 52/220 (81/229 somewhere) or 34/015, the preferred joints sets (J2 and J3) are 79/190 and 85/112 respectively. Widely spaced joints generate heavier and bigger sized key blocks/joint blocks, which are mostly metastable. Such metastable joint blocks may change into unstable key blocks on slight change in the state of stress acting on the blocks. Weathering is mostly confined along the EW striking joints. The soft clays are the main weathering products of the plagioclase and k-feldspars of the granites. Development of the clay minerals along the joint planes reduces the shearing strength of the rock mass. Saturation of the clay minerals during monsoon further reduces the shearing strength of the rock mass and hence may result in instabilities. Intensity of instability depends on the mechanical and chemical weathering of the rock mass. Degree of weathering and clay content along the joint plane is related to the orientation (dip/dip direction) of slope and altitude. Clay content is higher along the E—W striking joints of the gentler to moderately steeper slopes dipping towards N or S at the lower altitude. Clay content along the discontinuities of the granites in the higher altitude is very low and the weathering residues are more sandy nature. The roughness of the joint planes are higher and the shearing strength of the rock mass is higher. Falling and toppling of the blocks are more frequent along the higher altitudes and sliding (plane and wedge) instabilities are more frequent along the lower altitudes. Complex types of instabilities are more frequent along the mid slope (middle altitudes). Combination of structurally-, stress-, weathering- and subsurface-water controlled instabilities are prominent in complex types of instabilities.

Following methods are used for the study of the slope instabilities of the area; ①Interpretation of topographic maps; ②Interpretation of aerial photograph; ③Documentation and careful evaluation of rock outcrops including discontinuity system in the field; ④Kinematics of the rock slope instability using the computer based graphical method.

The slope instability hazards in the Palung massif is very high in the SE and SW facing steeper slopes and relatively less in the north facing gentler slopes of the Mahabharat range. Present study conclude following causes for the instability hazard in the area occupied by the Palung granite massif: ①Steep rocky slope in the discontinuous rock mass; ②Excessive joint water pressure in the open joints during monsoon; ③Weathered joint surface; ④Combination of different factors.

Key words: granite; instability; hazard; Lesser Himalaya; Central Nepal

References

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