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Safety assessment of weathered slopes by measuring shear wave velocity

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The reduction in shear strength of slope surfaces due to weathering is ubiquitous phenomenon in the regions where extreme environmental conditions prevail i.e. repeated change of temperature and moisture. Natural disasters such as earthquakes or heavy rainfalls thwart the potential stability of weathered slopes. The magnitude of such destruction is small in size but of a huge number, which has significant effects on infrastructure in the vicinity. In dealing with the slope instability problems for such regions, present as well as future mechanical properties of those slopes have to be elucidated. Therefore, envisagement of negative ageing behavior of geomaterial in laboratory, and elucidation of in-situ mechanical properties and depth of weathered surface layer in field takes precedence. In the present research, authors performed laboratory experiments on sedimentary soft rock which were obtained from Sagamihara, Japan to evaluate the change in mechanical properties (at unconfined as well as at low confinement state) due to accelerated mechanical weathering in laboratory. A drastic reduction in strength and stiffness was observed in unconfined laboratory weathering experiments; however there are no significant effects on mechanical properties in confined laboratory weathering tests. This finding is quite rational with the natural weathering process which takes place at shallow depths.

Field experiments were conducted to evaluate the shear-wave velocity, depth and in-situ shear strength of surface weathered layer which included seismic refraction, portable dynamic cone penetration and field direct shear tests. Field studies were conducted in Japan (Yokosuka, Nagano, Izu and Kobe) and Pakistan (Muzaffarabad and Taxila). The investigated sites were recently disturbed by strong earthquakes. By using the depth and shear strength of surface weathered layer safety analysis (infinite slope) was carried out both for dry and fully saturated state for all the sites investigated. Later, the safety factor was correlated to shear wave velocity, which suggested that the safety factor of a weathered slope reduces to half during the rainfall event. The authors envision to use this relationship for the direct evaluation of potentially unstable weathered slopes by measuring the slope angle and shear wave velocity of the surface weathered layer. In case of weathered slope, for an evaluated value of shear wave velocity if the corresponding safety factor for saturated case is less than unity, monitoring of shear wave velocity should be started and necessary actions should be taken in case of decrease in safety factor with time.