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STABILITY OF SLOPE CUTS IN PENINSULAR MALAYSIA

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In Peninsular Malaysia, thick weathering profiles are found over bedrock masses and have developed as a result of prolonged and pervasive chemical weathering. These weathering profiles are characterized by a morphological zonation, with each zone consisting of soil and/or rock material showing differences in the extent of preservation of minerals, textures and structures of the original bedrock material and mass. Slope cuts in the Peninsula have usually been excavated in such variable earth materials and it is this feature that is the single most important factor influencing their stability.

Granitic bedrock underlies the more hilly to mountainous areas of the Peninsula and shows weathering profiles that can be subdivided into three broad morphological zones, an upper Zone I of pedochemically and geochemically weathered bedrock, an intermediate Zone II of in-situ geochemically weathered bedrock and a lower Zone III of partly weathered to unweathered bedrock. Zone I is up to about 12 m thick and consists of soil material of a sandy clay to clayey sand texture, while Zone II is up to about 30 m thick and consists of material of a sandy silt to silty sand texture that indistinctly to distinctly preserves the textures and structures of the original bedrock mass. Unweathered corestones and core-boulders are also often found in the lower part of Zone II, while Zone III consists of unweathered bedrock that shows weathering effects along structural discontinuity planes only. Shallow cuts in granitic bedrock areas only expose Zone I material and are usually stable, though they are sometimes affected by shallow slips that occur long after the end of construction during periods of rainfall and are preceeded by the development of desiccation cracks within the Zone I material. Slope cuts of moderate heights expose material of Zones I and II, and have been affected by several small discontinuity plane controlled failures, as wedge failures, slab and block slides, for these discontinuity planes are often distinctly preserved in the Zone II material. Small shallow slips have also affected the Zone I material of these cuts. Larger failures of a slump-flow nature have also affected these cuts and result from the infiltration induced saturation of the slope material. Apparent cohesion is an important property of the Zone II material, for the cuts of moderate heights often appear stable even at steep angles, particularly when it is considered that the Zone II material shows a drained strength characterized by only a friction angle (Ø) value of about 38 to 42°. Very deep cuts expose material of morphological Zones I, II and III and are affected by the same types of failures that affect the shallower cuts, except for the Zone III material which is only affected by structural plane controlled failures as wedge failures, block and slab slides. Groundwater is not considered to be an important factor influencing the stability of the deep and shallower cuts, except in some cases, for groundwater tables are usually located below the slope failure surfaces.

Metamorphic bedrock is found in the undulating to hilly areas of the Peninsula and shows weathering profiles that can usually only be subdivided into two broad morphological zones, an upper thin to thick Zone I of pedochemically and geochemically weathered bedrock and a lower thick to very thick Zone II of in-situ geochemically weathered bedrock. Only in very deep slope cuts is the morphological Zone III of partly weathered to unweathered bedrock exposed. Zone I is from 2 to 10 m thick and consists of soil material of a silty to clayey texture, while Zone II is up to 30 m and more thick and consists of soil material of a silty texture that distinctly preserves the textures and structures of the original bedrock mass. Shallow cuts in metamorphic bedrock areas usually only expose Zone I material and are affected by shallow slips that occur during periods of rainfall long after the end of construction and are preceeded by the development of dessication cracks within the slope material. In many cases, these cuts are affected by slumps that occur under undrained conditions for the cuts usually intersect groundwater tables. Deeper cuts expose material of Zones I and II ana are usually affected by structural planes controlled failures as wedge failures, block and slab slides as relict foliation and joint planes are distinctly preserved in the Zone II material. Larger scale failures involving compound slides and slumps also affect these cuts and occur under both drained and undrained conditions.

Sedimentary bedrock outcrops over the undulating to hilly areas of the Peninsula and shows weathering profiles that can be subdivided into two broad morphological zones, an upper Zone I of pedochemically and geochemically weathered bedrock and a lower Zone II of geochemically weathered bedrock. Zone I is from 3 to 10 m thick and consists of soil material of a silty to clayey texture, while Zone II is up to 20 m and more thick and consists of sandy to clayey soil material that distinctly retains the textures and structures of the original bedrock. Shallow cuts in the sedimentary bedrock areas expose Zone I material and are affected by shallow slips, while deeper cuts expose Zones I and II and are affected by larger structural plane controlled failures. These failures include slab and block slides as well as wedge failures and usually occur during or following periods of rainfall after the end of construction. In low-lying areas, slumps involving Zone I material sometimes occur under undrained conditions, when shallow groundwater tables are present.