SEACAP 21/004
Mainstreaming Slope Stability Management – Hazard and Risk Assessment – to Laos Practitioners

Theme 1
Types of Slope Instability Affecting the Laos Road Network
SEACAP 21/004
Mainstreaming Slope Stability Management – Hazard and Risk Assessment – to Laos Practitioners

Theme 1.1
Landslide Mechanisms
Landslide mechanism refers to the ‘geometry’ of the surface(s) along with failure takes place. Landslides are generally classified according to whether they are:

- Slides (failing on discrete surfaces)
- Falls (detached material from steep slopes – frequent in cut slopes)
- Flows (often fast moving movements containing high water content)
Landslide mechanisms are usually determined by the materials involved:

- Soil derived from in situ weathering of rock (varies between sand or clay, depending on parent material and degree of weathering)
- Soil derived from downslope movement of material over time (colluvium)
- Rock (not yet weathered to form a soil and stability is controlled by jointing pattern)
SEACAP 21/004
Mainstreaming Slope Stability Management – Hazard and Risk Assessment – to Laos Practitioners

In Situ Weathered Soil, contains some of original rock structure
Colluvium, derived from downslope movement of material
SEACAP 21/004
Mainstreaming Slope Stability Management – Hazard and Risk Assessment – to Laos Practitioners

Rock Slope: Stability Controlled by Jointing
Common failure mechanisms

Slope Failures
- Plane Failures (in granular soil and rock)
- Wedge Failures (in rock)
- Rotational Failures (most common in clay soils)
- Debris Flows (in granular soils)
- Mud Flows (in clay soils)
- Falls (in soil and rock)

Retaining Wall Failures
- Wall failures above or below the road
- Landslide movements may cause walls to overturn
- Landslide movements may cause walls to lose foundation stability
The most common mechanism of slope failure along the Laos road network is the *plane* failure where movement occurs along a single plane approximately parallel to the slope surface, in either soil or rock.
SEACAP 21/004
Mainstreaming Slope Stability Management – Hazard and Risk Assessment – to Laos Practitioners

- Wedge failures occur in rock where two joints intersect and movement takes place along the combined surfaces
Rotational (or circular) failures take place along a concave failure surface and are usually associated with failures in clay soils, such as those derived from completely weathered rock.
Predominantly overturning movement to wall: Movement may create cracks in road surface and wall collapse; may require underpinning at toe of wall or total replacement on more stable foundation.

Weakening of foundation at toe due to erosion/scour of softening/weathering.

Predominantly horizontal sliding movement to wall: Movement may crack/block drain; repair/replacement increased (e.g., base width increased, shear key constructed) or driving forces reduced (e.g., slope regraded, slope drainage improved).

Deep failure in original ground beneath one or both walls: Differential movements may cause wall collapse; repair/replacement ineffective unless wall foundation taken down to stable ground below slip surface.
SEACAP 21/004
Mainstreaming Slope Stability Management – Hazard and Risk Assessment – to Laos Practitioners

Theme 1.2
Landslide Depth:
Shallow Vs Deep-Seated
Mainstreaming Slope Stability Management – Hazard and Risk Assessment – to Laos Practitioners

- Shallow landslides usually occur in soil and weathered rock and tend to have minimal impact on roads
  - Shallow landslides above the road usually result in blockage to side drains and adjacent carriageway
  - Shallow landslides below the road can lead to loss of the road shoulder

- Deep-seated landslides often occur in rock and can have significant impacts on roads
  - Deep-seated landslides above the road can cause road blockage and damage breast walls
  - Deep-seated landslides below the road can give rise to subsidence or loss of carriageway
SEACAP 21/004
Mainstreaming Slope Stability Management – Hazard and Risk Assessment – to Laos Practitioners

Theme 1.3
Landslide Location & Configuration with Respect to the Road: Above, Below or Through the Road
Cross-Section of Road Across a Slope
Possible Slope Failure Above the Road
Possible Slope Failures Below and Through the Road
SEACAP 21/004
Mainstreaming Slope Stability Management – Hazard and Risk Assessment – to Laos Practitioners

Theme 1.4
Typical Outcomes
Above Road Plane Failures in Rock and Soil in Over-steep Cut Slope
Above Road Plane Failures in Soil in Over-steep Cut
Fill Slope Failure on Steep Slope Below Road Exposing Road Shoulder Edge
Below Road Failure in Fill or Natural Slope
Through – Road Failure Leading to Subsidence of Road Surface
Rock Fall
Damage to Breast Wall by Cut Slope Failure
Road Fill Retaining Wall Failure Due to Landsliding on Slope Below