

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**

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Theme 1.1
Landslide Mechanisms

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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)

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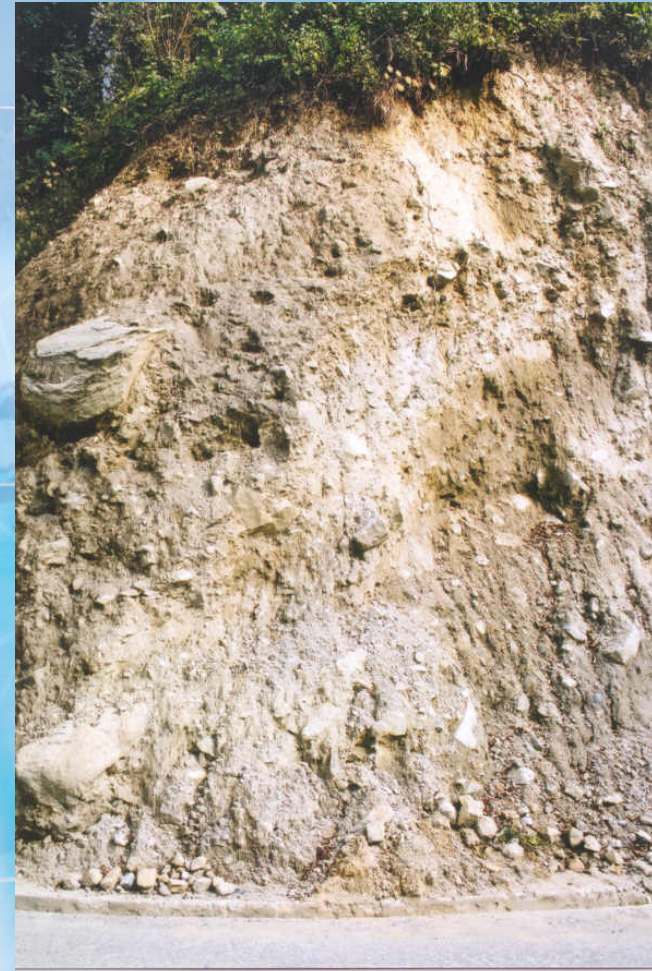
Landslide mechanisms are usually determined by the materials involved:

- **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)**

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**In Situ Weathered Soil,
contains some of original rock
structure**



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**Colluvium,
derived from
downslope
movement of
material**



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Rock Slope: Stability Controlled by Jointing



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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)

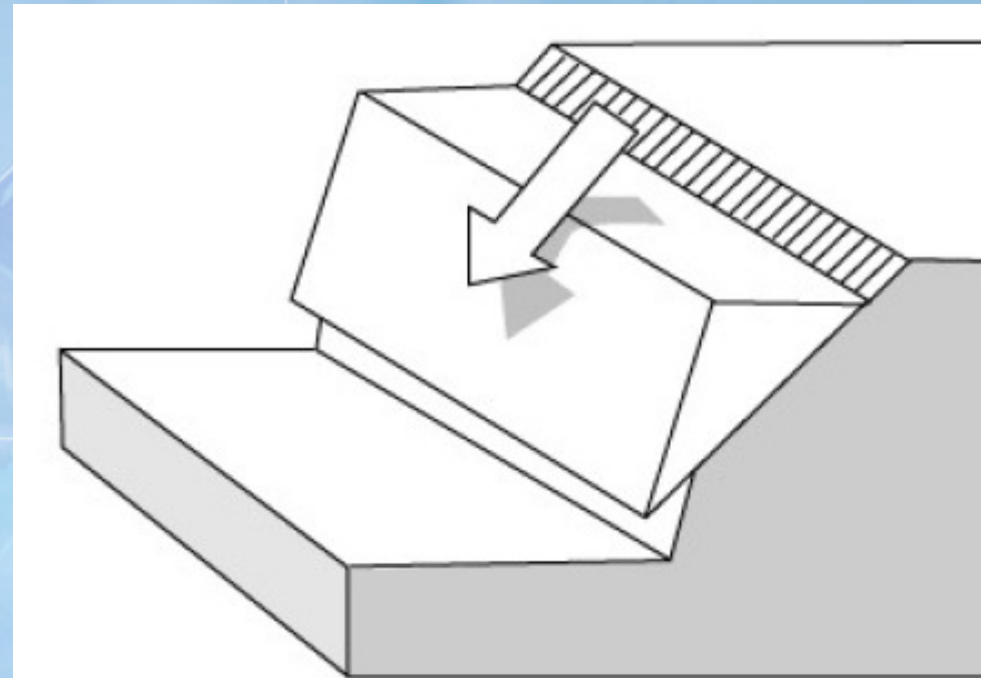
Retaining Wall Failures

- Wall failures above or below the road
- Landslide movements may cause walls to overturn
- Landslide movements may cause walls to lose foundation stability

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- 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.

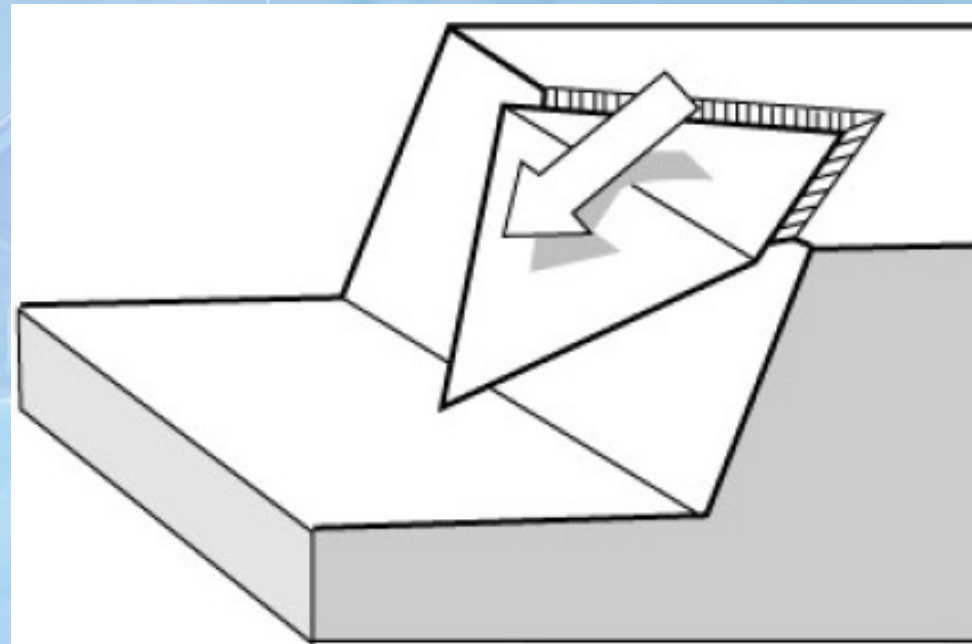


Planar failure in rock in which a discontinuity "daylights" the slope face

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- Wedge failures occur in rock where two joints intersect and movement takes place along the combined surfaces

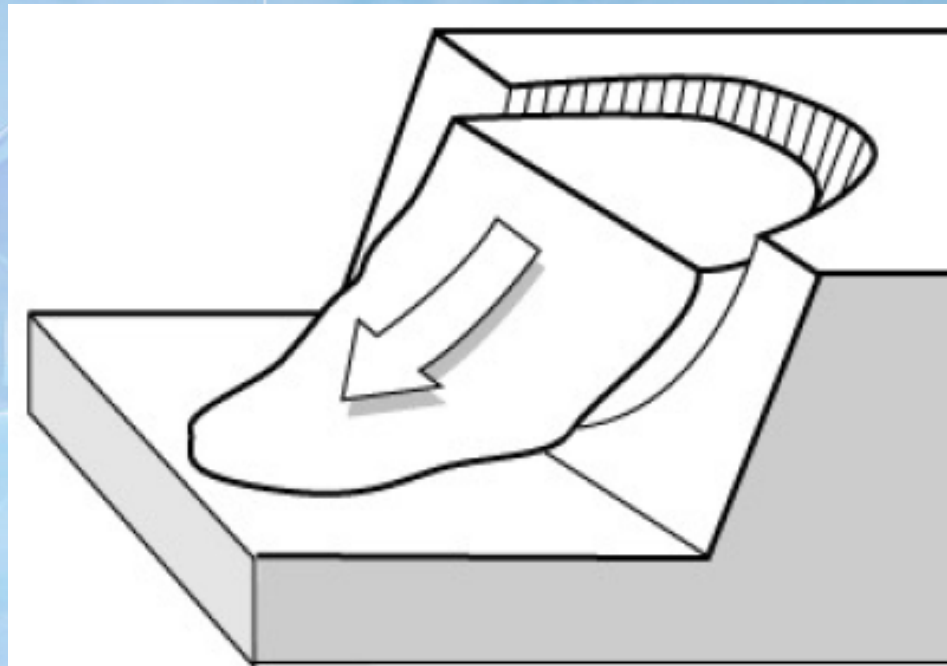


Wedge failure on two intersecting discontinuities with a line of intersection which "daylights" the slope

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- **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**



Circular failure in overburden soil, waste rock or heavily fractured rock with no identifiable structural pattern

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Theme 1.2
**Landslide Depth:
Shallow Vs Deep-Seated**

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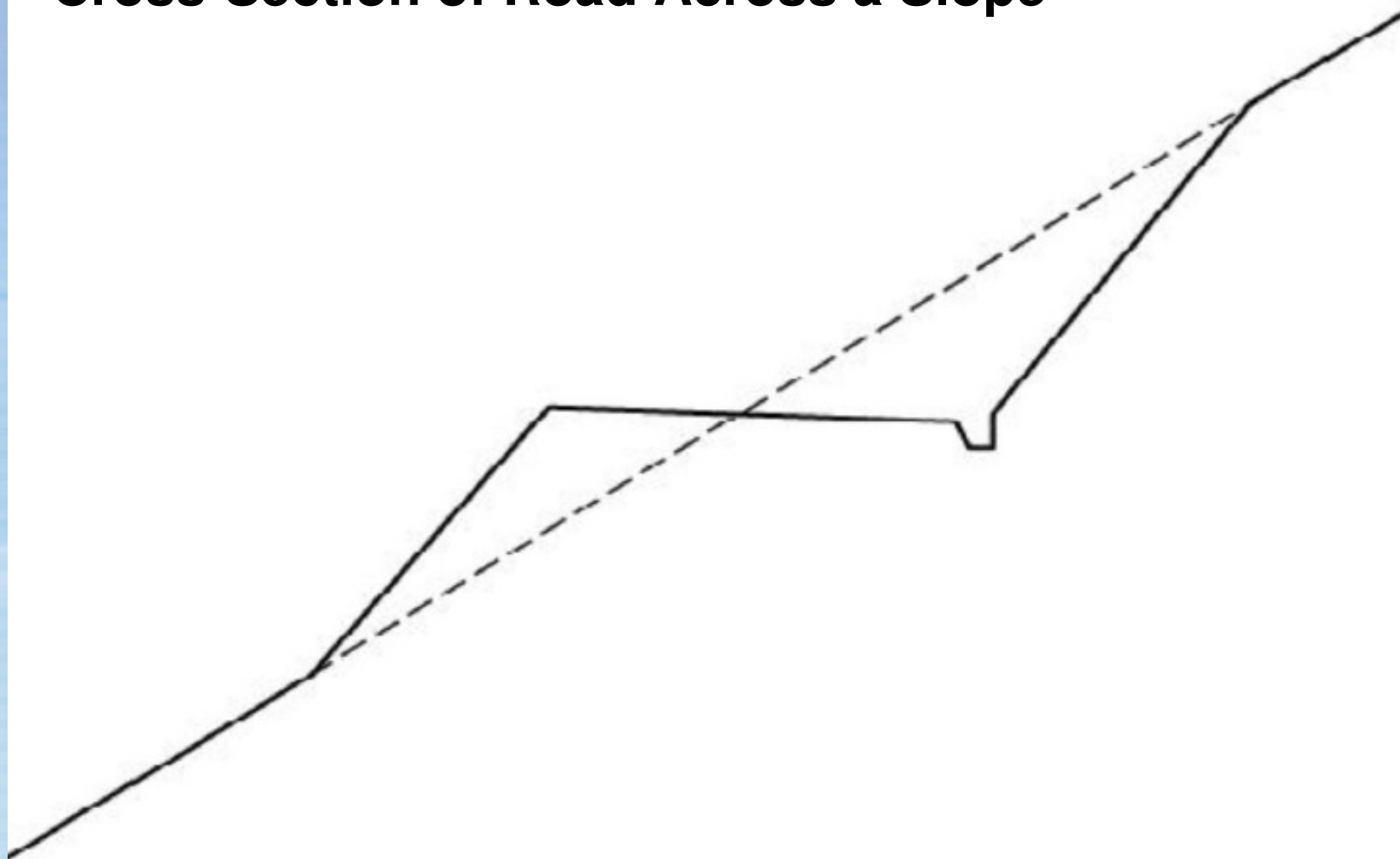
- **Shallow landslides usually occur in soil and weathered rock and tend to have minimal impact on roads**
 - **Shallow landslides above the road usually result in blockage to side drains and adjacent carriageway**
 - **Shallow landslides below the road can lead to loss of the road shoulder**

- **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**

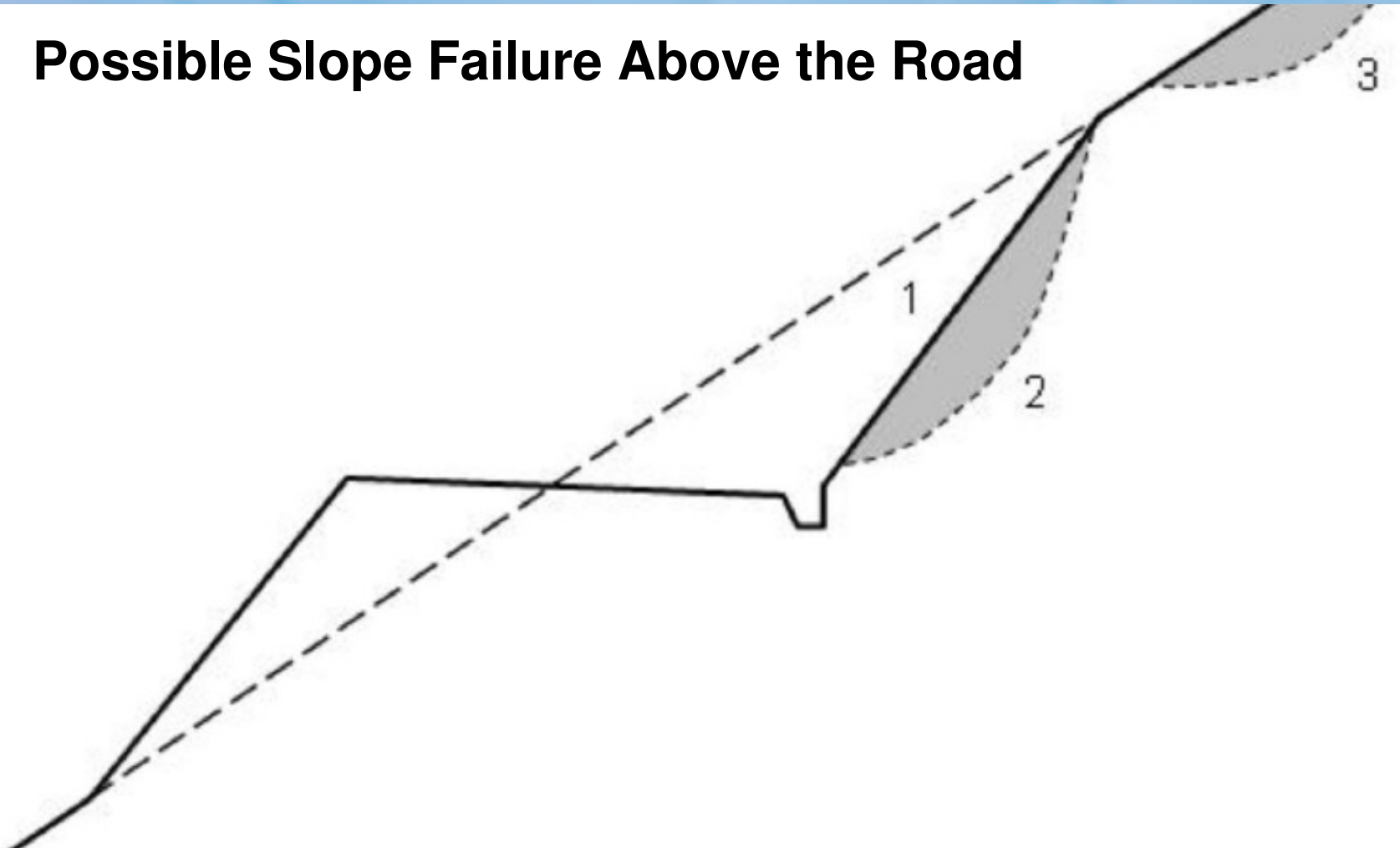
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Theme 1.3
Landslide Location & Configuration with Respect to the Road: Above, Below or Through the Road

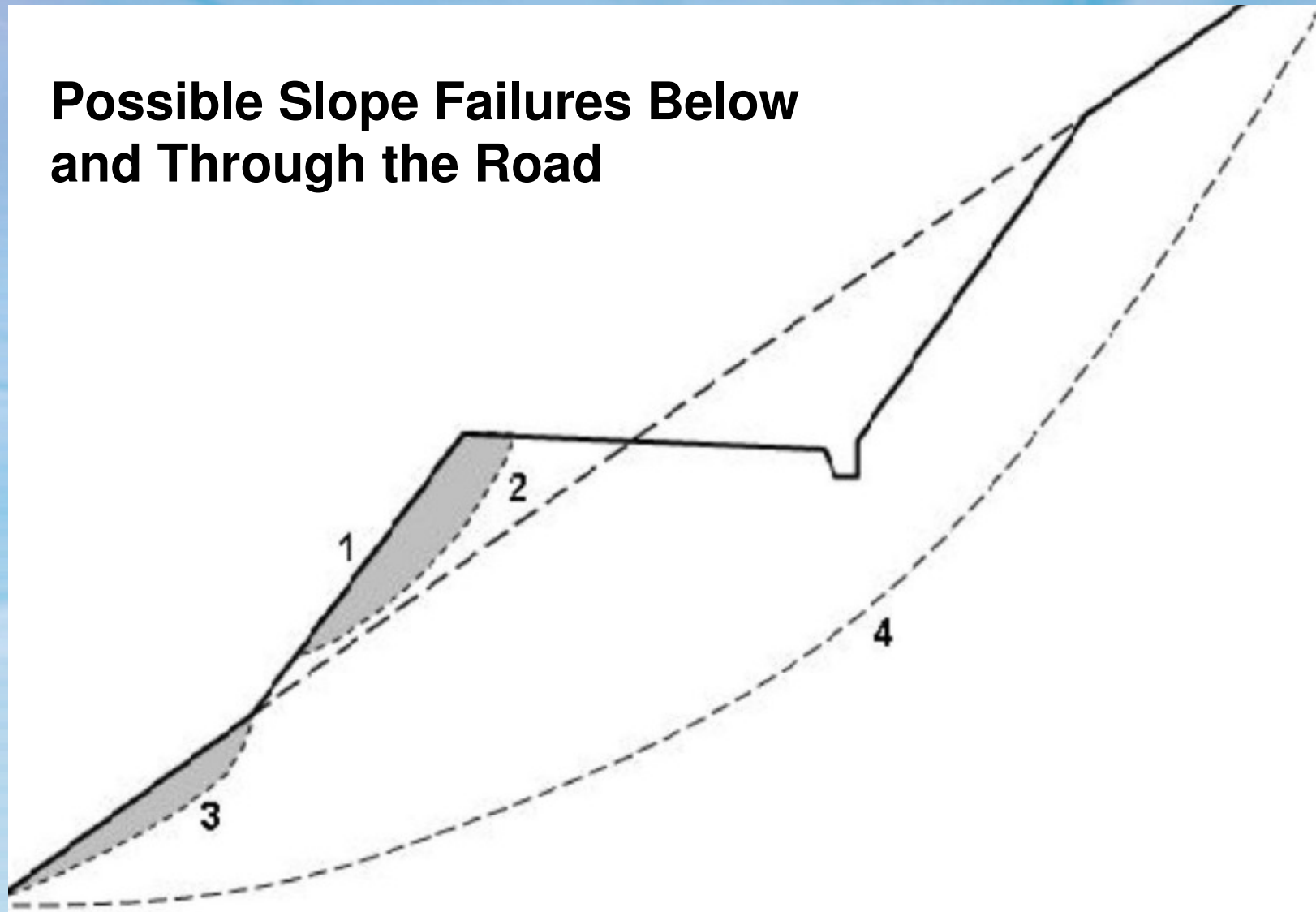
Cross-Section of Road Across a Slope



Possible Slope Failure Above the Road



Possible Slope Failures Below and Through the Road



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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



PARTNERING

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

