Limit Equilibrium Analysis – Metode Sederhana

DR. IR. NURLY GOFAR, MSCE

Limit Equilibrium Analysis

In general, there are two methods of limit equilibrium analysis i.e.:

Linear methods for relatively simple situation

- Slope in dry cohesionless soil
- Slope in cohesive soil (undrained condition)
- Infinite slope analysis for surface failure

Non-linear methods or Method of Slices which is necessary for complex situation involving irregular slope geometry, non-uniform soil condition, and slope analyses involving the consideration of seepage in soil.

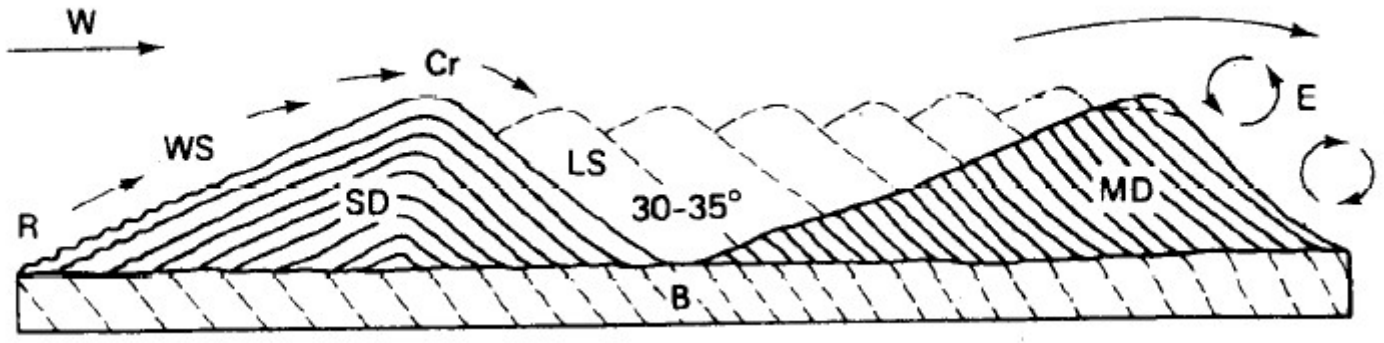
Read: Duncan and Wright (2005)
Soil Strength and Slope Stability
chapter 6

Linear method, dry cohesionless soil

$$FS = \frac{\tan \phi'}{\tan \beta}$$

where ϕ' = internal friction angle,

β = slope angle/angle of repose



When slope angle (β) of a sand slope > ϕ, the sand slope tends to fail by sliding in a downhill direction parallel to the slope

The greatest slope for free-standing cohesionless soil = ϕ

The slope angle at which a loose sand fails may be estimated by its angle of repose, the angle formed by sand as it forms a pile below a funnel through which it passes

Linear method,

Slope in Homogeneous Cohesive soil (ϕ= 0 analysis)

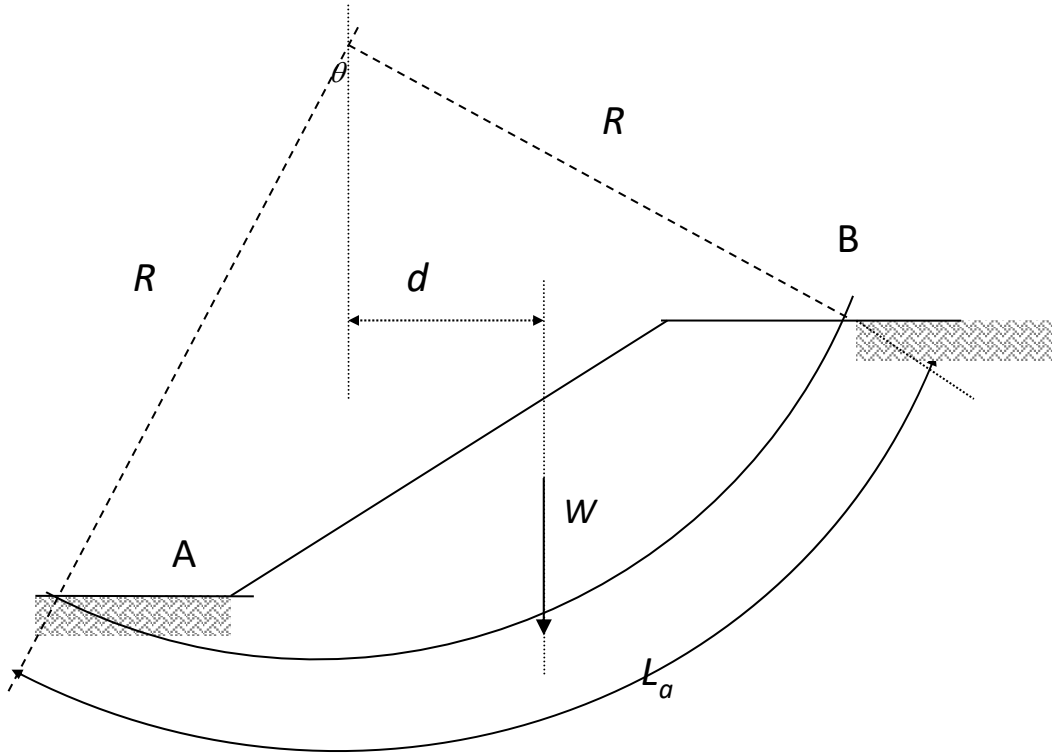
In homogeneous cohesive soils relatively unaffected by faults or bedding, deep seated shear failure surfaces tend to form in a circular, rotational manner.

This failure plane sometimes reached interface between the soil and the stronger layer underneath the soil.

The slope with larger inclination will have a shallow failure plane as compared to those with small slope angle.

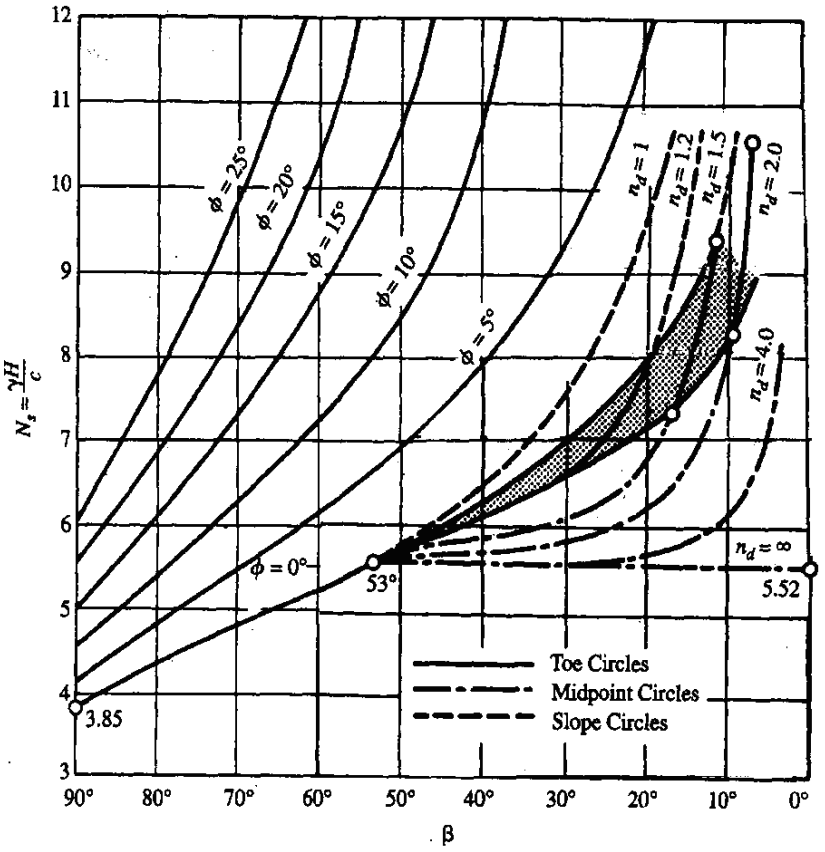
Factor of safety

$$FS = \frac{c_u \, L_a \, R}{W \, d}$$

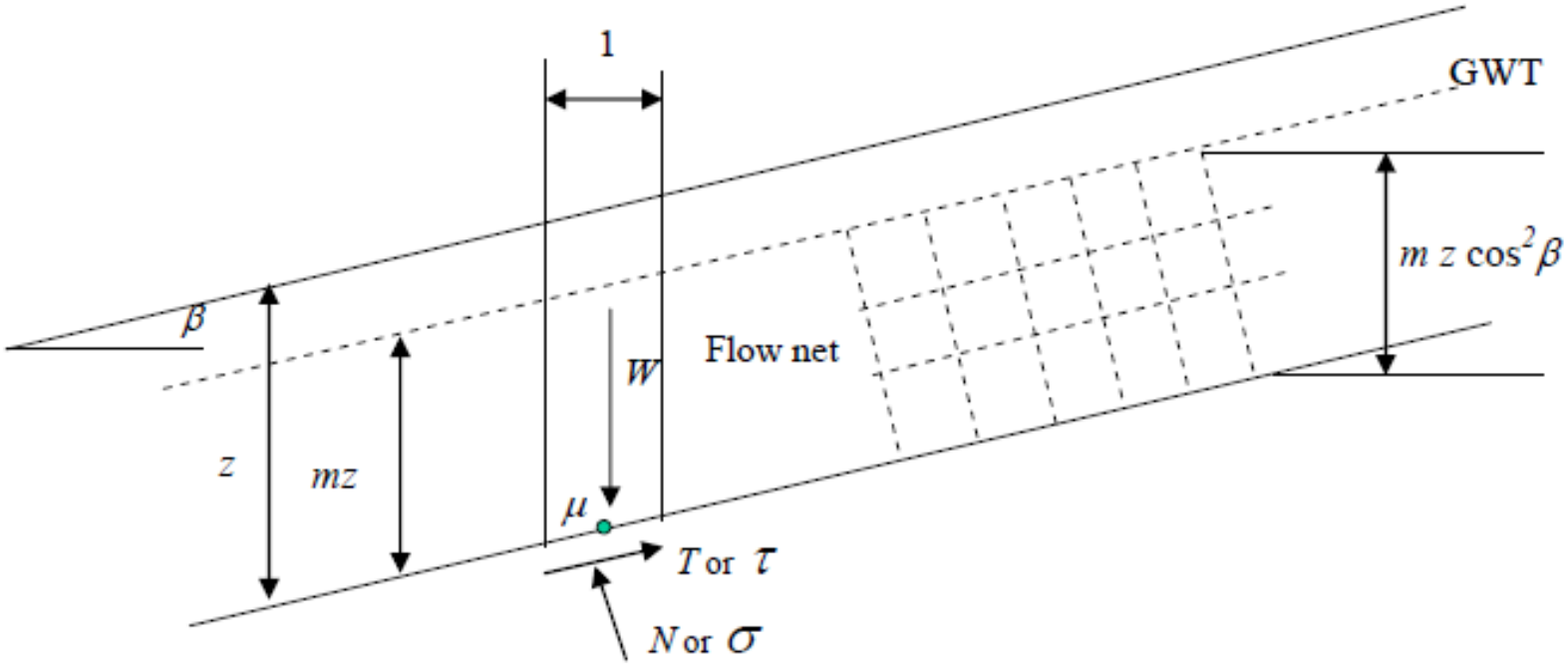


Stability number method (Taylor's chart)

$$FS = \frac{N_s \; c_u}{\gamma H}$$



Linear Method: Infinite Slope Analysis



failure surface is parallel to the ground surface

factor of safety is assumed constant along the failure plane.

The equation for factor of safety (*FS*) of infinite slope with failure plane of depth *D* can be used to determine the stability of a slope against surface failure.

$$FS = \frac{c' + \gamma' D \cos^2 \beta \tan \phi'}{\gamma_b D \cos \beta \sin \beta}$$

where ϕ' is the effective friction angle, c' is the effective cohesion, γ_b is the wet density and γ' is the buoyant density of the soil. The slope forms an inclination β.