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SLOPE STABILITY ANALYSIS METHODS

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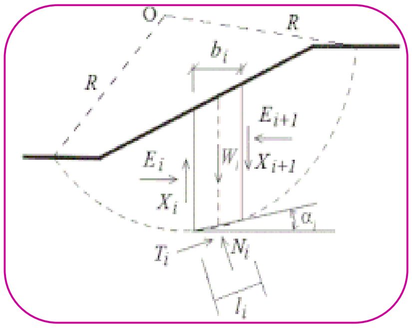
ABSTRACT:

In this paper, the fundamental formulation of the two-dimensional (2D) slope stability methodology are mentioned. Presently, the speculation and code for two-dimensional slope stability square measure rather mature.

KEYWORDS : *slope stability methodology , speculation.*



INTRODUCTION

There square measure 2 other ways for effecting slope stability analyses. the primary approach is that the total stress approach that corresponds to clayey slopes or slopes with saturated sandy soils beneath short-run loadings with the pore pressure not dissipated. The second approach corresponds to the effective stress approach that applies to long stability analyses during which drained conditions prevail. For natural slopes and slopes in residual soils, they must be analysed with the effective stress technique, considering the utmost water level beneath severe rainstorms.[1-3] this can be notably necessary for cities like port wherever intensive precipitation might occur over an extended amount, and also the formation will rise considerably once a rainfall.

Table1 **Summary of system of equations (*n* = number of slices)**

Equations	*Condition*
n	Moment equilibrium for each slice
2*n*	Force equilibrium in *X* and *Y* directions for each slice
n	Mohr–Coulomb failure criterion
4*n*	Total number of equations

Table 2 **Summary of unknowns**

Unknowns	*Description*
1	Safety factor
n	Normal force at the base of slice
n	Location of normal force at base of slice
n	Shear force at base of slice
n–1	Inter-slice horizontal force
n–1	Inter-slice tangential force
n–1	Location of inter-slice force (line of thrust)
6n–2	Total number of unknowns

Force equilibrium

The horizontal and vertical force equilibrium conditions for slice *i* are given by:

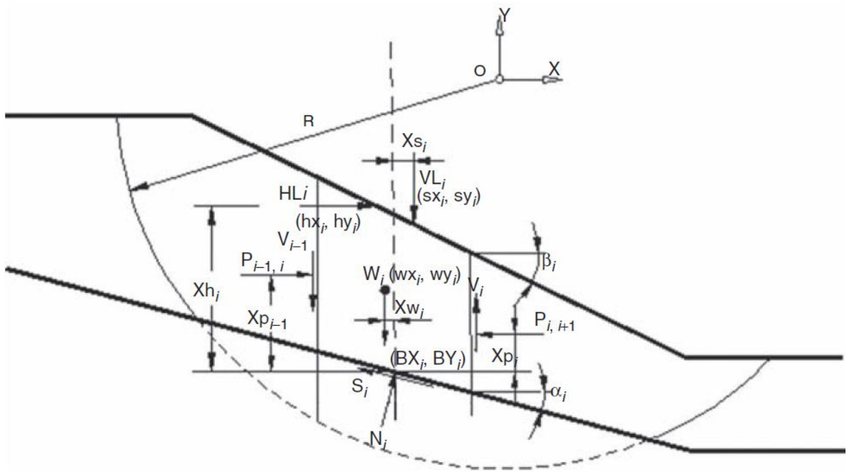


Figure 1 Internal forces in a failing mass.

$$N_i \sin\alpha_i - S_i \cos\alpha_i + HL_i = P_{i,i+1} - P_{i-1,i} \quad (1)$$

$$W_i + VL_i - N_i \cos\alpha_i - S_i \sin\alpha_i = P_{i,i+1} \tan\phi_{i,i+1} - P_{i,i+1} \tan\phi_{i,i+1} \quad (2)$$

The Mohr–Coulomb relation is applied to the base normal force N_i and shear force S_i as

$$S = \frac{N_i \tan\phi_i + c_i l_i}{F} \quad (3)$$

The boundary conditions to the above three equations are the inter-slice normal forces, which will be 0 for the first and last ends:

$$P_{0,1} = 0; \quad P_{n,n+1} = 0 \quad (4)$$

When *i* = 1 (first slice), the base normal force N_1 is given by eqs (2.5)–(2.7) as

$$N_1 = \frac{A_1 \times F + C_i}{H_1 + E_1 \times F}, \quad P_{1,2} \frac{L_1 + K_1 \times F + M_1}{H_1 + E_1 \times F} \quad (5)$$

$P_{1,2}$ is a first order function of the factor of safety *F*. For slice *i* the base normal force is given by

$$N_i = \frac{(\tan\phi_{i-1,i} - \tan\phi_{i1,i})F \times P_{i-1,i} + A_i \times F + C_i}{H_i + E_i \times F} \quad (6)$$

$$P_{i,i+1} = \frac{(J_i \times f_i + G_i \times F)P_{i-1,i} + L_i K_i \times F + M_i}{H_i + E_i \times F} \quad (7)$$

When $i = n$ (last slice), the base normal force is given by

$$N_n = \frac{AA_n \times F + D_n}{J_n + G_n \times F}, \quad P_{n-1,n} = -\frac{L_n + K_n \times F + M_n}{J_n + G_n \times F} \quad (8)$$

: Eqs (7) and (8) relate the left and right inter-slice traditional forces of a slice, and therefore the subscript i,i + one means that the interior force between slice i and that i + one. Definitions of symbols utilized in the on top of equations square measure

$$A_i = W_i + VL_i - HL_i \tan\phi_{i,i+1}, \qquad AA_i = W_i + VL_i - HL_i \tan\phi_{i-1,i}$$
$$C_i = (\sin\alpha_i + \cos\alpha_i \tan\phi_{i,i+1})c_i A_i, \qquad D_i = (\sin\alpha_i + \cos\alpha_i \tan\phi_{i-1,i})c_i A_i$$
$$E_i = \cos\alpha_i + \tan\phi_{i,i+1}\sin\alpha_i, \qquad G_i = \cos\alpha_i + \tan\phi_{i-1,i}\sin\alpha_i$$
$$H_i = (-\sin\alpha_i - \tan\phi_{i,i+1}\cos\alpha_i)f_i, \qquad J_i = (-\sin\alpha_i - \tan\phi_{i-1,i}\cos\alpha_i)f_i$$
$$K_i = (W_i + VL_i)\sin\alpha_i + HL_i\cos\alpha_i \qquad V_i = P_{i,i+1}\tan\Phi_{i,i+1}$$
$$L_i = (-(W_i + VL_i)\cos\alpha_i - HL_i\sin\alpha_i)f_i, \quad M_i = (\sin^2\alpha_i - \cos^2\alpha_i)c_i A_i$$
$$A_i = W_i + VL_i - HL_i \tan\phi_{i,i+1}, \qquad B_i = W_i + VL_i - HL_i \tan\phi_{i-1,i}$$

where

α	–	base inclination angle, clockwise is taken as positive;
β	–	ground slope angle, counter-clockwise is taken as positive;
W	–	weight of slice; *VL* – external vertical surcharge;
HL	–	external horizontal load; *P* – inter-slice normal force;
V	–	inter-slice shear force; *N* – base normal force;
S	–	base shear force; *F* – factor of safety;
c, *f*	–	base cohesion *c′* and tanϕ′;
l	–	base length *l* of slice, tanΦ = λ*f(x)*;

{*BX, BY*}, coordinates of the mid-point of base of every slice; , coordinates for the centre of gravity of every slice; , coordinates for purpose of application of vertical load for every slice; coordinates for the purpose of application of the horizontal load for every slice; *Xw*, *Xs*, *Xh*, *Xp* are lever arm from middle of base for self weight, vertical load, horizontal load and line of thrust, respectively, where *Xw* = *BX* – *wx*; *Xs* = *BX* – *sy*; *Xh* = *BY* – *hy*.

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