STATIC AND SEISMIC STABILITY ANALYSIS OF VARIOUS SLOPES AND RETAINED BACKFILLS BY CONSIDERING CONSTANT/VARIABLE SATURATION STATE

A Thesis

Submitted for the Degree of

Doctor of Philosophy

In the Faculty of Engineering

By

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Under the supervision of

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Dedicated to my

Friends &Family

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Sourav Sarkar

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LIST OF NOTATIONS

a_h = Horizontal seismic acceleration

a_v = Vertical seismic acceleration

B_i = Integration constants

c = Cohesive strength of homogeneous soil slope.

c_u = Undrained cohesive strength

c_{u0} = Undrained cohesive strength at interface

c_1 = Cohesive strength of top layer soil

c_2 = Cohesive strength of bottom layer soil

c_{eq} = Equivalent cohesive strength of rock mass

c_r = Reduced cohesive strength

D_f = Disturbance factor of rock mass

D_i = Integration constants

F_v = Vertical seismic force

F_h = Horizontal seismic force

F_s = Critical factor of safety

F_{min} = Minimum value of factor of safety

F_{max} = Maximum value of factor of safety

f_i = Slope surface

GSI = Geological Strength Index

H, h = height of slope

h_m = Suction head

h_w = Depth of ground water table

k_s = Saturated hydraulic conductivity

k_r = Relative hydraulic conductivity

k_v = Vertical seismic acceleration coefficient

k_h = Horizontal seismic acceleration coefficient

K_a = Coefficient of active earth pressure for the saturated soil

K_p = Coefficient of passive earth pressure for the saturated soil

K_{ae} = Coefficient of seismic active earth pressure

K_{pe} = Coefficient of seismic passive earth pressure

K_{ou} = Coefficient of earth pressure at rest condition in the vadose zone

K_{au} = Coefficient of active earth pressure in the vadose zone

K_{pu} = Coefficient of passive earth pressure in the vadose zone

K_{aue} = Seismic active earth pressure coefficient for unsaturated soil

K_{pue} = Seismic passive earth pressure coefficient for unsaturated soil

m = Cohesion gradient (Chapter 3)/Asymmetry parameter of vG-SWCC model (Chapter 6)

m_i = Non-dimensional material strength parameters of intact rock mass

m_b = The reduced value of the dimensionless material constant m_i of broken rock mass

n = Total number of slices (Chapter 3)/Pore size distribution (Chapter 6)

N = Stability number

N_i = Normal force of i^{th} slice

p_{active} = Active earth pressure

$p_{passive}$ = Passive earth pressure

p_s = Surcharge load

Q = Flow Ratio

q = Surface flux

s = Degree of fracturing of the rock mass

S_i = Shear stress of i^{th} slice

S_e = Effective degree of saturation

S_r = Residual degree of saturation

t = Time

t_{opt} = Optimum thickness of top layer

u_a = Pore air pressure

u_w = Pore water pressure

W = Self-weight of the failure soil wedge (Section 8.3.2)

W_i = Weight of the i^{th} slice

x_0 and x_n = Abscissas of two endpoints where the slip surface intersect with the slope surface

y_i = Slip surface

α = vG and Gd-SWCC model parameter

β = Slope angle

γ = Unit weight

γ_b = Bulk unit weight of the soil

σ_1 = Major principal stresses

σ_3 = Minor principal stresses

σ_{ci} = Uniaxial compressive strength of intact rock

σ'_{3max} = Upper limit of the confining stress upto which the EMC* criterion is matched with the GHB** criterion

σ_{ni} = Normal stress of i^{th} slice

σ_n = Normal stress

σ^s = Suction stress

σ^s_{norm} = Normalized suction stress

σ^s_{avg} = Average Suction stress

η = Seismic intensity

η_c = Critical seismicity

τ = Shear strength

τ_f = Shear stress

θ = Volumetric water content

θ_r = Residual volumetric water content

θ_s = Saturation volumetric water content

θ_i = Inclination angle of the i^{th} slice

Θ_n = Normalized volumetric water content

ϕ = Friction angle

ϕ_u = Undrained friction angle

ϕ' = Effective frictional angle

ϕ_1 = Friction angle of top layer

ϕ_2 = Friction angle of bottom layer

ϕ_{eq} = Equivalent friction angle of rock mass

ϕ_r = Reduced friction angle

ϕ = Internal friction angle of homogeneous soil slope

ψ = Matric suction

ψ_{norm} = Normalized matric suction

*EMC= Equivalent Mohr-Coulomb Criterion,

**GHB= Generalized Hoek-Brown Criterion

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