Back analysis for landslide occurrence based on the relationship between the rain and the slope condition.

*Reiko AKIYAMA[1], Kuniaki MIYAMOTO[2]

1. Oriental Consultants Co., Ltd., 2. Nippon Koei Co., Ltd.

Studies on the prediction of the location and time of landslide occurrence have been actively conducted. The method of dynamic prediction by the slope stability model from the slope conditions, and the groundwater depth generated has made possible for landslide simulation based on the digital elevation model.In this study, the landslide occurrence based on the infinite slope stability model is normalized by the slope gradient and the unit volume weight of the soil layer. Then the water conditions and slope conditions at the time of the landslide occurrence are reversed for the landslide cases. Application results by the method are introduced in this report. The infinite slope stability model is generally expressed by the ratio of shear stress to resistance in the surface soil layer (Eq-1). This was organized by Fc and Fw as described in Imaizumi *et al.*[2003].In this time, the normalization parameter F_{CC} composed of the slope conditions (including the soil cohesion) was introduced into the soil cohesion force term, and when the safety factor Fs equals 1.0, it was normalized by the internal friction angle of the soil. It is shown as the relationship between the slope gradient, and the groundwater depth term due to the groundwater depth normalized by the soil layer thickness (Eq-2).In this paper, examples of estimating the soil layer thickness, and soil cohesion by applying the method to shallow landslides caused in Izu Oshima in the 2013, as well as to the landslides in the Amehata River basin in 1960-1970 are introduced. In this report, the result of trying to back analysis the assumed soil depth from the slope angle where the landslide is distributed is explained.

Keywords: Landslide, infinite slope stability model, back analysis, soil depth

$$F_s = \frac{W}{G} = \frac{c + (\bar{\rho} g D - \rho g h)\cos I \tan\phi}{D \bar{\rho} g \sin I} < 1.0 \quad \cdots\cdots \text{Eq-1}$$

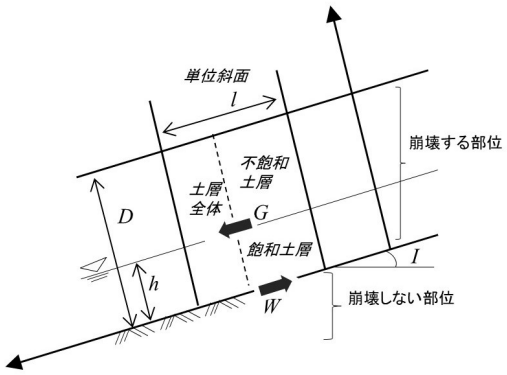
$$\bar{\rho} = \left\{ G_s(1-\lambda) + \lambda S_r + (1-S_r)\lambda \frac{h}{D} \right\} \rho$$

In case $F_s = 1.0$

$$F_{cc} = 1 - \frac{1 - F_w}{\frac{\tan I}{\tan\phi}} \quad \cdots\cdots \text{Eq-2}$$

$$F_w = \frac{\rho}{\bar{\rho}} \frac{h}{D}$$

$$F_c = F_{cc} \frac{\tan I}{\tan\phi} = \frac{1}{\bar{\rho}} \frac{c}{D g \sin I} \frac{\tan I}{\tan\phi}$$



c=Soil cohesion, ϕ = Internal friction angle, Gs=soil particle density
ρ=Water density, h= Water depth, g=Gravitational acceleration,
D=Soil depth, I=Slope angle, λ=Porosity, Sr= Degree of saturation

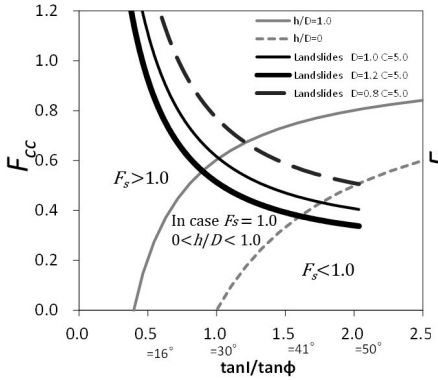


Fig.1 Okanesawa (c=5.0 kN/m²)

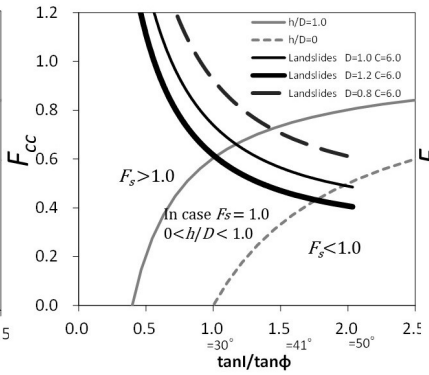


Fig.2 Okanesawa (c=6.0 kN/m²)

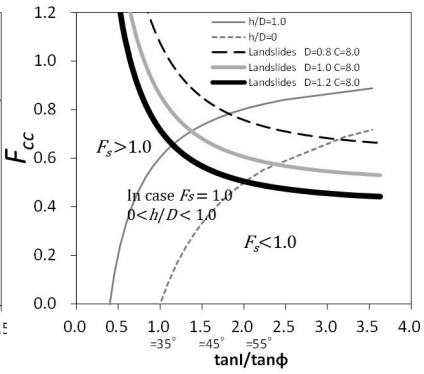


Fig.3 Inamatadani river(1982) (c=8.0 kN/m²)

