

# 公路土壤邊坡崩塌監測系統維護及模組功能提升

Upgrading of wireless monitoring modules and maintaining of testing sites for highway slope failures

主管單位：交通部運輸研究所  
合作單位：財團法人成大研究發展基金會

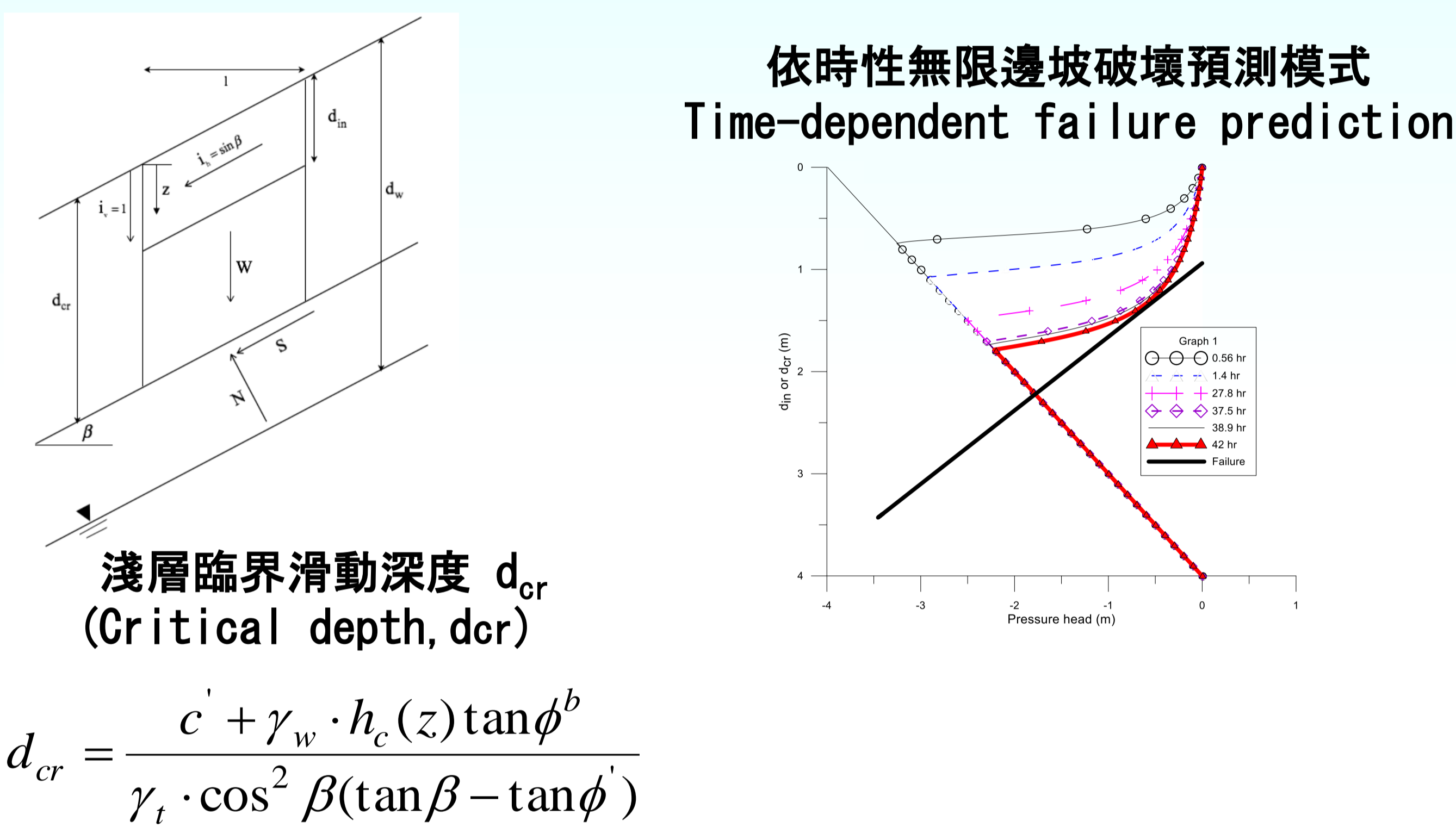
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## 整體目標 Overall objective

本計畫針對前期建置之公路邊坡崩塌監測測試場址進行維護及資料處理，並對現有監測模組進行功能提升，新增阿里山五彎仔路段監測場址，模組提升主要為廣域網路更新為4G網路，此外本年度新增公路邊坡擋土系統監測與預警值分析功能，以PYWALL軟體分析擋土牆破壞前變形，建立擋土支撐系統傾角及背填水位雙重指標預警值，另建構專屬整合雲端儲存與顯示功能之雲端平台。

This project continues the on-going research to maintain the testing sites and upgrading the modules to 4G network. A new shallow failure site located in Highway 18 has been added in this study. A new module for retaining wall inclination monitoring is deployed and a soil-structure interaction program PYWALL is adopted to predict the pre-failure deformation of the retaining wall. A cloud platform capable of data storage, display, and warning is also developed.

## 水力力學耦合邊坡穩定分析 Coupled hydro-mechanical slope stability analysis

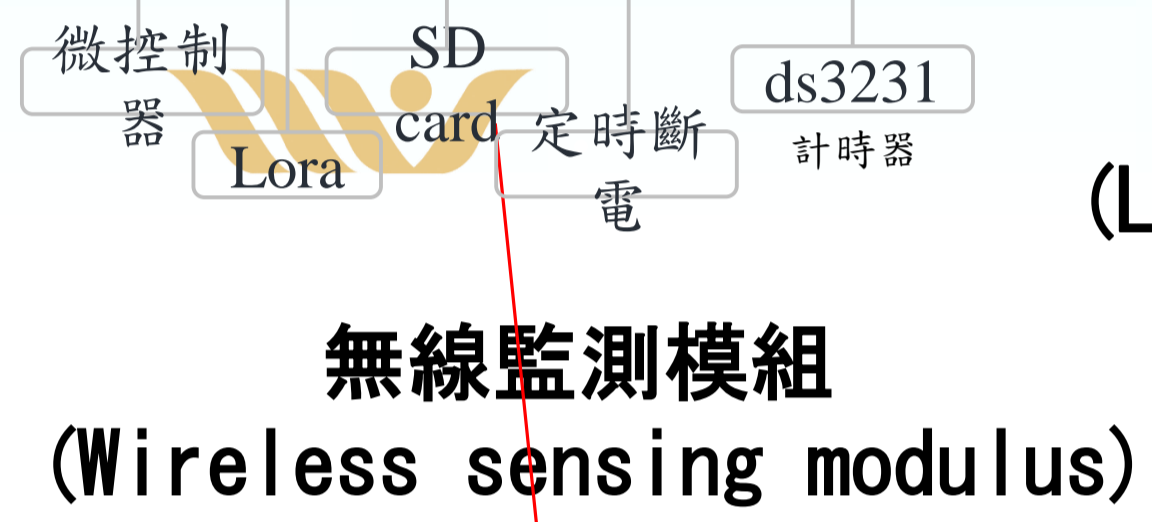
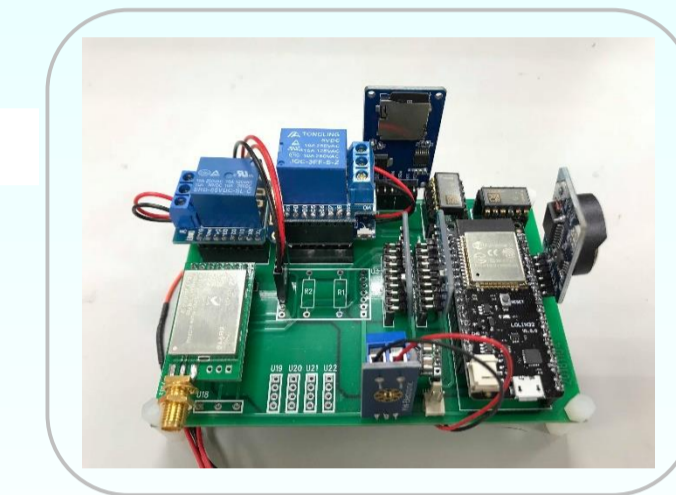


深層滑動安全係數  
(FS of deep-seated slide)

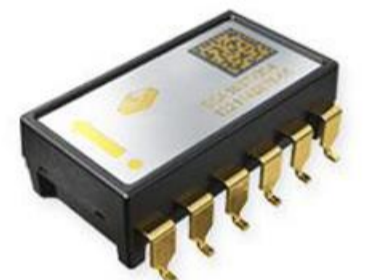
$$FS = \frac{c'}{\gamma_{sat} d_{cr} \sin \beta \cos \beta} + \left( \frac{\gamma_{sat} - \gamma_w r_u}{\gamma_{sat}} \right) \frac{\tan \phi'}{\tan \beta}$$

## 土層無線監測模組 Slope wireless sensing modulus

太陽能供電模組  
(Solar power module)



液位計  
(Liquid level meter)



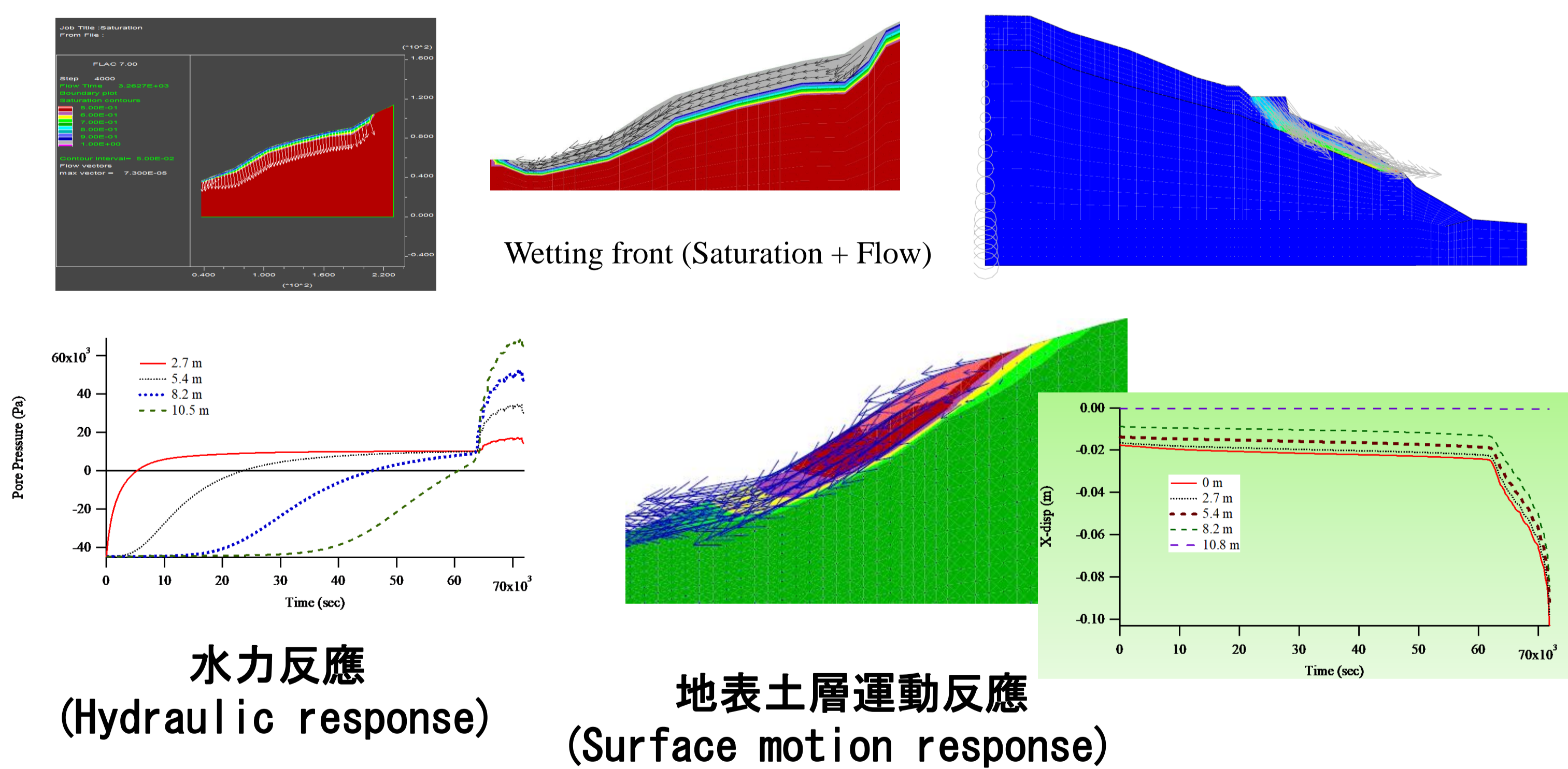
電容含水量計  
(Capacitance moisture probe)



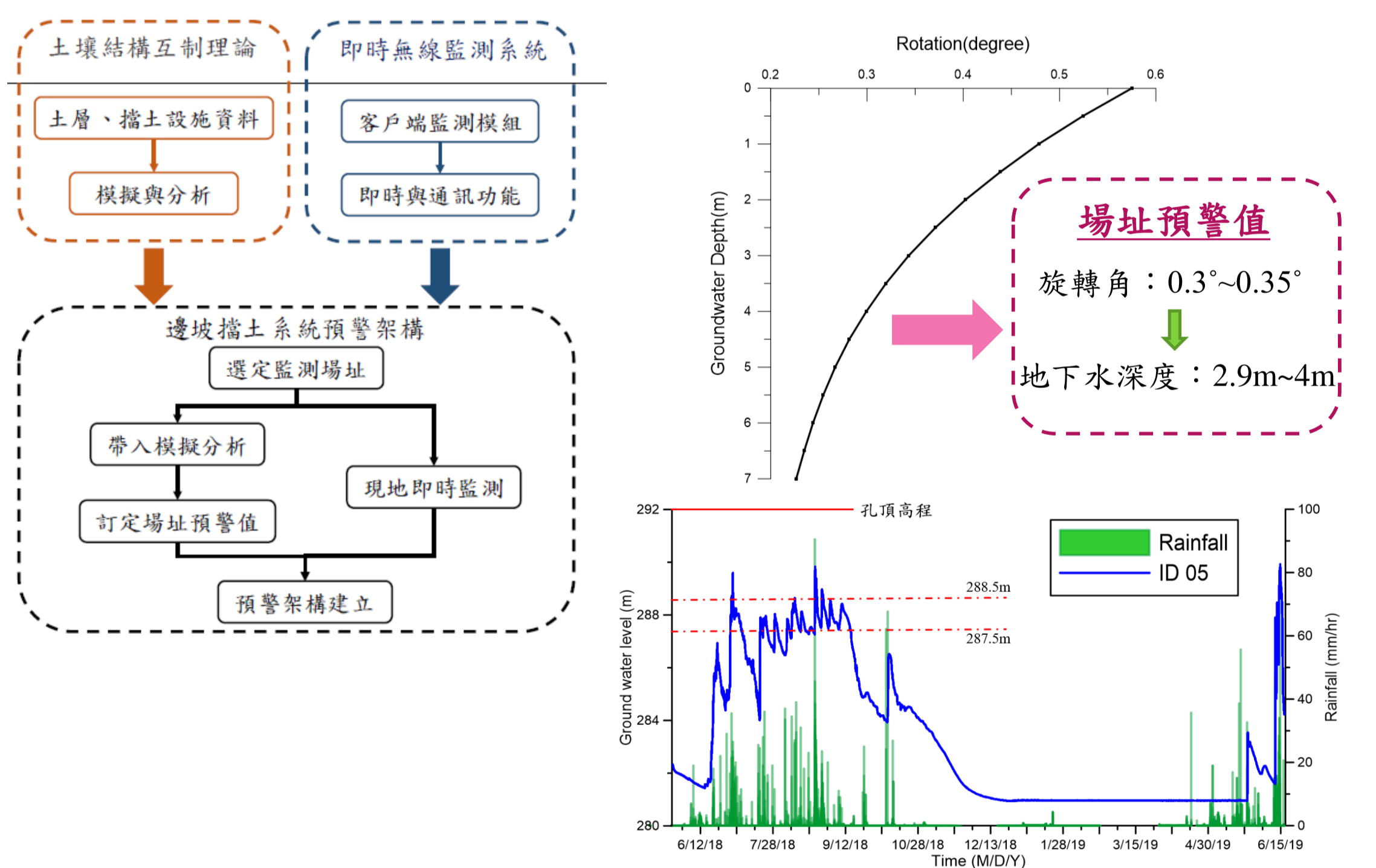
電容含水量計  
(Capacitance moisture probe)

## 研究成果 Current progress

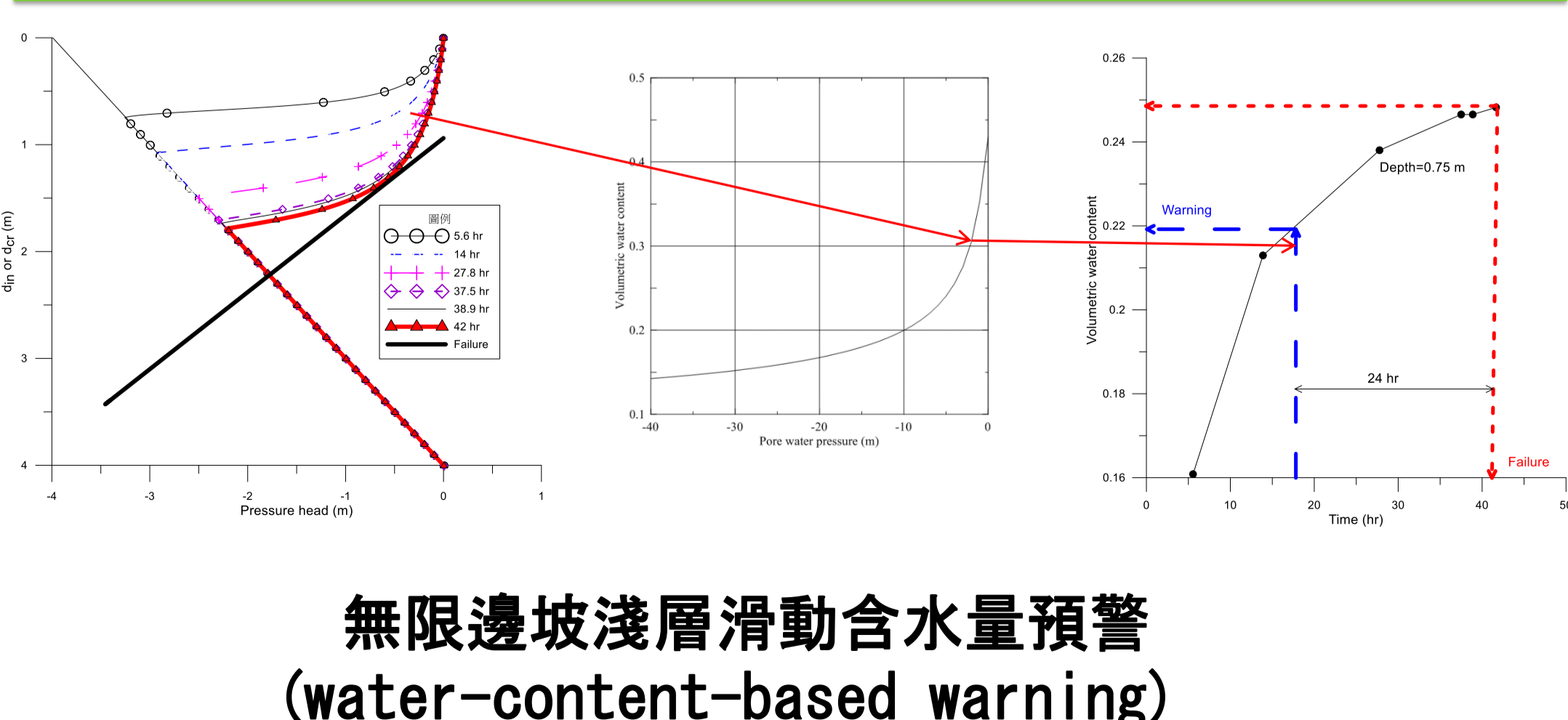
### 二維水力力學耦合邊坡分析 2D hydro-mechanical slope stability analysis



### 擋土系統變位預警架構 Warning system for slope retaining system



### 依時預警模式 (Time-dependent warning system)



### 雲端整合平台 Cloud integration platform

