

0206花蓮地震之斷層地表變形破裂 與人工設施互制關係

詹佩臻
青山工程顧問股份有限公司

謝沛宸 陸安 柳鈞元 林劭儒 李健宏 林銘郎
國立臺灣大學土木工程學系

黃韋凱
財團法人中興顧問社防災科技研究中心

摘要

2018年2月6日花蓮地震造成花蓮市多處地表變形破裂，並造成人工設施不同程度的破壞型態，其破裂跡大致與1951年花東縱谷序列地震相當，顯見斷層錯動具再現性。經現地調查發現，地表破裂跡於陸域部分，北起七星潭社區，南至南濱公園出海，再往南花蓮大橋亦受斷層錯動產生橋面版偏移、擠壓。本文根據現地調查成果，利用三維顆粒體離散元素PFC3D軟體，探討0206花蓮地震之米崙斷層及嶺頂斷層錯動引致地表覆土層變形與人工設施互制之關係。研究成果顯示，當斷層錯動時，模擬無人工設施之自由場地表破裂跡明顯產生雁行排列，而模擬建物位於斷層面不同距離顯示，當建物位於地表破裂變形帶中，會產生不同程度之旋轉、偏移及下陷等變形且破裂跡有繞過建物之現象；另結合無人飛行載具(UAV)產製三維立體點雲資訊，藉以比對花蓮大橋受斷層錯動所產生之變形及變位，模擬成果大致與現地觀察之變位量相當，因此，利用三維顆粒體離散元素法有助於了解人工設施近斷層帶或跨越斷層線型可能之變形行為。

關鍵字：斜移斷層、地表破裂跡、分離元素法(PFC3D)、斷層與人工設施互制、米崙斷層、嶺頂斷層。

Numerical Simulation of Interaction between Surface Rupture and Structure of the 0206 Hualien Earthquake

Pei-Chen Chan

Land Engineering Consultants Co. Ltd.

Pei-Chen Hsieh An Lu Chun-Yuan Liu Shao-Ru Lin Chien-Hung Li Ming-Lang Lin

Department of Civil Engineering, National Taiwan University

Wei-Kai Huang

Sinotech Engineering Consultant, Inc.

Abstract

During the 0206 Hualien Earthquake in Taiwan, many infrastructures were damaged to different extents. Although several researchers have studied surface fault ruptures, the interaction between structures and fault ruptures have not been completely investigated. In this study, we perform a 3D distinct element method (PFC 3D) to simulate full-scale ground deformation and structure damage induced by the sinistral strike-slip fault. The free field model with 60 degrees fault dip angle presented the Riedel shear and the negative flower structure with 50 m wide primary deformation zone. Buildings located in the deformation zone would be damaged (e.g., displacement, rotation, and subsidence) to different degrees and the rupture trace would bypass along buildings in view of the distance to the fault tip. The Hualien Bridge intersected the Lingding Fault orthogonally. The 0206 Hualien Earthquake caused a sinistral-displacement about 70 cm between pier #9 and pier #10 and a 10 cm dextral-displacement in deck #13. The numerical model reveals that such situation could be related to the fault offset. Our preliminary results indicate that the 3-D distinct element method shows a potentiality to elucidate the interaction between near-fault co-seismic deformations and infrastructures.

Key Words : oblique slip faulting, surface rupture, distinct element method (PFC3D), fault and structure interaction, Milun fault, Lingding fault.