

The Deformation of Overburden Soil and Interaction with Pile Foundations of Bridges Induced by Normal Faulting

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According to the investigations of well-known disastrous earthquakes in recent years, ground deformation induced by faulting is one of the causes for engineering structure damages in addition to strong ground motion. Most of structures located on faulting zone has been destroyed by fault offset. Take the Norcia Earthquake in Italy (2016, $M_w=6.2$) as an example, the highway bridge in Arquata crossing the rupture area of the active normal fault suffered a quantity of displacement which causing abutment settlement, the piers of bridge fractured and so on. However, The Seismic Design Provisions and Commentary for Highway Bridges in Taiwan, the stating of it in the general rule of first chapter, the design in bridges crossing active fault: "This specification is not applicable of making design in bridges crossing or near active fault, that design ought to the other particular considerations". This indicates that the safety of bridges crossing active fault are not only consider the seismic performance, the most ground deformation should be attended.

In this research, to understand the failure mechanism and the deformation characteristics, we will organize the case which the bridges subjected faulting at home and abroad. The processes of research are through physical sandbox experiment and numerical simulation by discrete element models (PFC3-D). The normal fault case in Taiwan is Shanchiao Fault. As above, the research can explore the deformation in overburden soil and the influences in the foundations of bridges by normal faulting. While we can understand the behavior of foundations, we will make the bridge superstructures into two separations, simple beam and continuous beam and make a further research on the main control variables in bridges by faulting. Through the above mentioned, we can then give appropriate suggestions about planning considerations and design approaches.

This research presents results from sandbox experiment and 3-D numerical analysis to simulate overburden soil and embedded pile foundations subjected to normal faulting. In order to validate this numerical model, it is compared to sandbox experiments. Since the 3-D numerical analysis corresponds to the sandbox experiments, the response of pile foundations and ground deformation induced by normal faulting are discussed. To understand the 3-D behavior of ground deformation and pile foundations, the observation such as the triangular shear zone, the width of primary deformation zone and the inclination, displacements, of the pile foundations are discussed in experiments and simulations. Furthermore, to understand the safety of bridges crossing faulting zone. The different superstructures of bridges, simple beam and continuous beam will be discussed subsequently in simulations.